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SUPPLEMENT: THE STRUCTURE AND PROPERTIES OF DIAMOND
BY SIR C. V. RAMAN

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ERRATA

Vol. 12, No. 4, April 1943: Note entitled "Synthesis of Sulphanilamide Derivatives of Thianthrene", page 119, para 2, line 6, the melting point of the diamine *should be* 102° C., and *not* 120° C. as printed.

Vol. 12, No. 5, May 1943: Notes entitled 1. "Suppression of Radio Interference from Electric Motors", page 146, para 3, line 7, *for* "36 commutator segments" *read* "18 commutator segments". 2. "An Equation for the Percolation of Water in Sodium-Calcium Soils", page 155, columns 1 and 2, and page 156, column 2, *for* "$Y = ae^{-b}S$" *read* "$Y = ae^{-bs}$." 3. "Inclined Extinction in the Hyperthenes of Charnockites", page 157, Fig. 1, tilt-zone 212-213 *to be co-zonal* with zone 101-11.

Vol. 12, No. 8, August 1943: Note entitled "The *Kurram santonica*", page 233, para 1, line 7, *for* "Kurrum santonin" read "*Kurram santonica*"; at the end of the Note, *for* "M. A. Qazilbash" *read* "N. A. Qazilbash".

Vol. 12, No. 10, October 1943: Note entitled "Virus Diseases of Potatoes in India", page 279, para 2, line 7, *after* "to", *add* "plants with", and *after* "symptoms" *insert* a comma; line 14, *for* "such", *read* "the"; para 3, line 6, *for* "(*Solanum* virus 2)" *read* "(*Solanum* virus 2)[1]; para 4, line 5, *after* "U.P." *add* "and elsewhere"; second column, para 2, line 2, *for* colon after "plants" *use* full stop.

Vol. 12, No. 11, November 1943: Notes entitled 1. "Coconut Shells as an Industrial Raw Material: I. Composition of Shells", page 292, in the table, *for* "SO_2" *read* "SiO_2; page 292, para (iii), 'Organic Constituents', line 2, *for* "W. L. Winton" *read* "A. L. Winton"; line 5, *for* "species" *read* "spices". 2. "Origin of Rohr at Didwana", page 295, para 3, line 3, *for* "months" *read* "weeks"; page 297, Table III, (1) Raw Brine, $NaCl:Na_2SO_4$, column 3, *for* "2·8°:1" *read* "22·82:1".

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CURRENT SCIENCE

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PROBLEMS OF POST-WAR AGRICULTURAL RECONSTRUCTION

AFTER the war is over and peace is restored, there will arise problems of social and economic repair and reconstruction. Agricultural reconstruction will have to receive prior consideration. Farming will be the first to be re-established in the areas that have suffered from war and being also the occupation of the bulk of the world population, the reconstruction of agriculture is the basis of national reconstruction. These tasks which should be considered well in advance of the need, demand expert knowledge, careful thought, clear vision, and planning with foresight.

The lead given by the British Association for the Advancement of Science is, therefore, none too early. Through its Division for the Social and International Relations of Science, the Association arranged, in March this year, a Conference for the discussion of plans for the post-war reconstruction of agriculture in Europe. A large number of experts from the different countries of Europe participated in the Conference and made valuable contributions. Although the discussions were chiefly on plans for the re-establishment of agriculture in the devastated and oppressed areas of Europe and on the alleviation of the effects of famine and disaster, it was recognised that in the general problem of reconstruction the solution of immediate problems were closely interwoven with long-term policies and that, therefore, urgent plans should be linked up with long-term plans.

India, like Europe and the rest of the world, will have her post-war problems. A merciful Providence has so far spared India the horrors and disasters which her less fortunate sister-countries are suffering from. And so, her immediate post-war problems may not be similar to those of Europe and other Eastern countries of Asia. But linked up as she is with the outside world and its affairs, she has to play an important part directly or indirectly in the re-establishment of agriculture in the devastated areas. She has also her own urgent and long-term socio-economic and socio-political problems of reconstruction, special

and peculiar to herself and in dealing with these, her plans of reconstruction have to be in consonance with world policies.

The situation arising out of current war conditions such as changes in cropping systems necessitated by loss of export markets for certain crops and by the "grow more food" campaign, and the effects of inadequate nutrition and disease will need technical examination and practical adjustments as and where necessary. Occupation and instruction in matters of agriculture, village and domestic welfare, will have to be provided for the peasant-soldier returning from war.

Since the beginning of the century, the Central and Local Governments have been paying systematic and sustained attention to agricultural and rural development. After the experience of the devastating famines of the last century followed by epidemics and loss of life, an agricultural policy was laid down. Research institutions were established for the scientific study of agricultural and livestock problems. The realisation of risks to agricultural industry through drought and erratic rainfall resulted in an irrigation policy and network of irrigation canals in various parts of the country. A Land Improvement Loans Act and an Agriculturist Loans Act were enacted as early as 1883 and 1884 to counteract agricultural indebtedness, and a further measure in this direction was the passing of the Co-operative Credit Societies Act in 1904 on the recommendation of the Famine Commission of 1901. With the advent of popular Governments following the Reforms Acts of 1920 and 1935, rural development and rural reconstruction came into prominence in recent years. Not only the Central and Local Governments began to take a more active interest in the work of rural uplift but some of the social and political organisations have made it part of their programme. As the result of research, intractable waste lands have been conquered, crop yields have been increased, and good breeds of work and milch cattle have been developed.

The net result is that several government departments and non-official organisations have been actively concerning themselves with the welfare of the village and the farmer. The results achieved are imposing. If more and quicker results have not been achieved, that is due mainly to causes which although beyond the control of individuals, are nevertheless, within the nation's power to remedy.

The present social and economic system in the country and the relation between production and distribution are ill-balanced. Village life should be enriched by suitably moulding the prevailing social and economic order including systems of land tenure and occupancy, so that work and worker are brought together and people may create wealth by their own efforts. As one member said at the Conference on European Agriculture, the basis for reconstruction is the realisation that man is more important than the soil. The restoration and maintenance of individual self-respect, self-reliance and a healthy condition of mental and spiritual health is of paramount importance.

The increase in the population and its pressure on land are vitally concerned in the problems of reconstruction. From the standpoint of food and nutrition there is no need for alarm or anxiety. Our agricultural resources, provided they are properly husbanded, can be depended upon to feed not only the present normal population and the population which has now to stay away in the country owing to the stoppage of emigration, but also the emigrant population that has returned. The country can find food for even more. In regard to the standard of living it is really the standard of the home and any rise in the standard can come principally from the standard of the village and this is closely connected with the balance in production and distribution, with the spread between agricultural and industrial prices, educational facilities and the training of the young.

The greatest and the most difficult of the problems are those arising from the laws and customs of inheritance and the division of land. The division into small holdings has gone on to such an extent that in many cases farming has ceased to pay and is carried on in the absence of something better. Because of this, the purchasing power of the farmer is reduced. Agricultural improvement is hampered, unemployment is increased and in consequence the standard of living and nutrition falls to a low level. Consolidation of holdings and collectivisation as a remedy are not without their drawbacks. The possible consequences are increase in unemployment,

loss of individuality, and despair and discontent taking the place of the sense of pride in ownership and possession. The key problem is the problem of small holdings and peasant agriculture.

Crop-planning is not likely to be helpful in counteracting the evils of small holdings. In the first place there is the tendency towards self-sufficiency in Provinces and States. In the second place there are likely to be difficulties in carrying out the planning. It will be difficult owing to the inherent inability of small farmers to adapt their production to the changing conditions in the economic situation and to secure a certain unity of control in production and marketing. In the case of industries and trades this can be achieved by the elimination of small producers. But in agriculture the majority of producers are small farmers and they cannot be eliminated.

The reorientation and the co-ordination of agricultural and industrial policies, which appear to have satisfactory results in Belgium seem entitled to careful consideration. As Mr. M. L. Borremans pointed out, Belgium which is one of the most highly industrialised countries, is rarely thought of as an agricultural country. Belgium, however, is a country of small holdings and according to the census of 1930, nearly three-fourths of the total agricultural holdings were less than two and a half acres in size. These small holdings which are scattered all over the country and amongst which industries and factories are located, operate as part-time holdings. According to Mr. Borremans, the part-time holdings are a special feature of social conditions in rural Belgium constituting a semi-agricultural and semi-industrial unit in which agricultural and industrial life are intermixed. The real characteristic of part-time holdings is that the family in a village is split up between agriculture and industry, and not that it is working at certain times on the farm and at other times in industry.

The farmer is becoming more and more self-conscious. His thinking has undergone a new orientation. He needs more income and more buying power. The masses of people expect and demand to be fed, clothed and housed better than before. An awakened peasant population and masses cannot be expected always to think cogently and act wisely. Nor can they be expected to have the patience to wait long if not indefinitely. Small holdings and peasant agriculture are the key problems and further progress is possible in proportion as solutions are found to the key problems. They have to be thought out and planned in advance if results are to be attained peacefully and successfully.

B. VISWANATH.

SIR JNANCHANDRA GHOSH, Kt., D.Sc., F.N.I.

AMONGST the men of science in India included in the New Year Honours List *Current Science* notices with great pride and pleasure the name of Dr. Jnanchandra Ghosh, who has been knighted.

It is not easy for this *Journal* to give either formal or adequate expression of congratulations and good wishes to the distinguished recipient of the honour because, Sir J. C. Ghosh is an integral part of *Current Science* itself—being the President of the Current Science Association which runs this periodical. Both in this capacity and otherwise, Sir J. C. Ghosh's counsel, support and influence have nourished and sustained *Current Science* which, like any other young and growing institution in its early years, has not been without its teething troubles.

Nor is this the occasion to take stock of Sir J. C. Ghosh's scientific achievements and his service to Indian industry. Reticence which is imposed and inevitable during the war must necessarily preclude a full picture being drawn of his great contribution to the gearing of scientific research to industry during the last three years. Happily, Sir J. C. Ghosh is young enough to look forward to many more years of scientific endeavour which, all those who know him have no doubt, will be rich in achievement.

Sir J. C. Ghosh's contacts with Indian science and industry have been unusually many and varied. As a teacher of science and a mentor of schools of research, as the director of the foremost Indian institution devoted to science, as one of the earliest members of the Indian Science Congress which has honoured him by electing him to the highest offices in its gift and as a

member of a very large number of academic bodies, committees and organisations which initiate, organise and finance Indian scientific research, publish the results thereof and shape policy in correlating the results of research to the needs of agriculture and industry, Sir J. C. Ghosh has played a leading part during the last two decades. And in every one of these many diverse fields, his personal qualities and quiet charm of manner have won for him the loyalty, esteem and friendship of a host of admirers.

It is characteristic of Sir J. C. Ghosh's innate modesty that at the first public meeting he took part after being knighted (as President of a meeting of the South Indian Science Association on January 11, 1943), he said that he preferred to consider the honour not as a personal distinction but as a tribute to all those who shared in the scientific endeavour centred at Bangalore. *Current Science* can think of no more appropriate wish on this happy occasion than to say: May scientific endeavour in Bangalore continue to be honoured thus for many, many more years to come!

RAO BAHADUR B. VISWANATH, F.I.C., C.I.E.

THE happy news that Rao Bahadur Viswanath, Offg. Director, Imperial Agricultural Research Institute, New Delhi, has received the distinction of C.I.E. will be read with immense satisfaction by his numerous friends and colleagues in the scientific world. Rao Bahadur Viswanath is a pioneer in agricultural research and has been responsible for building up a

strong and enthusiastic school of agricultural science both at Coimbatore and now at Delhi. His work on the effect of farmyard manure in raising the vitaminic potency of the crops raised on it, remains one of the classical pieces of work carried out by him.

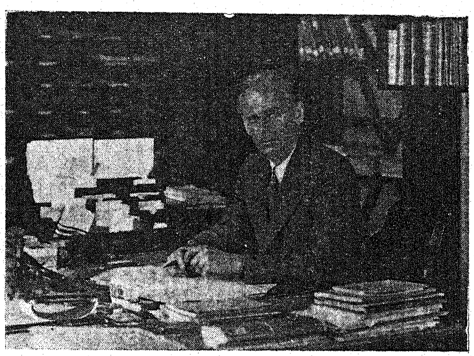
During the post-war period of the last World War, Rao Bahadur Viswanath played a prominent part in helping the agriculturists to grow more food by the application of phosphatic manures, and by the adoption of scientific methods of agriculture. To-day he is at the helm of the Imperial Agricultural Institute, and with the unbounded energy

and vigorous drive characteristic of him, he is organising the 'grow more food campaign' not only to obtain food materials in quantity but of a quality which will keep the nation free from hunger and free from disease. This is the greatest service which any scientist can render to his country.

We wish to offer him our heartiest felicitations on the honour he has won and wish him a long and eventful career of greater achievement and higher distinction.

DR. W. R. AYKROYD, C.B.E., M.D., Sc.D.

It is a great pleasure to offer Dr. Aykroyd our felicitations on the occasion of the conferment of the C.B.E. in the New Year Honours list. Dr. Aykroyd succeeded Sir Robert McCarrison in 1935 as the Director, Nutrition Research Laboratories, Coonoor. Prior to this appointment, while working in the Health Section of the



League of Nations, he wrote in collaboration with Dr. E. Burnet, the report "Nutrition and Public Health", which won him international fame in the field of nutrition. Dr. Aykroyd is a member of the Technical Commission on Nutrition of the League of Nations. In India, the credit of systematic analysis of various Indian foodstuffs and also of initiating, all over the country, filed experiments in practical nutrition especially with school children, goes to Dr. Aykroyd. He is also responsible for starting propaganda work in the field of nutrition, setting up a fine museum in the Laboratories and also starting a training course in nutrition for health officers, which attracts persons from different parts of India every year. Dr. Aykroyd has published two books on nutrition and numerous scientific papers. We wish Dr. Aykroyd a long life and many more distinctions to crown his labours.

SIR S. S. BHATNAGAR, Kt., O.B.E., D.Sc., F.Inst.P., F.N.I.

We are happy to announce that Sir S. S. Bhatnagar has been elected an honorary member of the Society of Chemical Industry, London, in recognition

of his *"manifold contribution to knowledge and his selfless devotion to scientific and academic duties"*. We wish to offer him our respectful felicitations on this distinction.

GRACIOUS MESSAGE FROM H. H. THE MAHARAJA OF MYSORE TO THE EIGHTH ANNUAL SESSION OF THE INDIAN ACADEMY OF SCIENCES

The Palace,
Mysore,
22*nd December* 1942.

I have heard with great pleasure that the Eighth Annual Meeting of the Indian Academy of Sciences is to be held at Bangalore under the distinguished presidentship of Rajasabhabhushana Sir C. V. Raman. The publications and periodical meetings of the Academy and other similar bodies are serving as a clearing house of information relating to the researches undertaken by scientific workers in India. By coming together and comparing results and experiences from time to time, they are enabled to pursue their respective lines of study with increased confidence and in a spirit of mutual collaboration, and there is every ground for the hope that Indian scientists will continue to make substantial contributions to the stock of scientific knowledge. The Academy is also striving to make the lay public realise the importance of scientific research as an instrument of human progress and happiness, and its efforts in this direction deserve encouragement.

I wish the Conference all success.

(*Sd.*) JAYACHAMARAJA WADIYAR.

SCIENCE AND THE CENSOR

SCIENTISTS in general and physicians in particular will be disturbed by the correspondence which has passed between the postal censor and Dr. J. McKeen Cattell, Editor of *Science*, and which appears in the current issue of that Journal. That censorship in war is necessary no one will deny. But was the censor justified in deleting from *Science* an item on a new sulfa drug which can be used with good effect in such intestinal infections as dysentery, because our enemies in tropical regions might learn how to return the afflicted men rapidly to the fighting line? From time immemorial military surgeons have made no distinction between friend and foe in dealing with wounds and disease. In 1917 both the Surgeon-General of the Army and the Secretary of War decided that for humanitarian reasons publication of information about an antitoxin developed in this country to combat the bacillus of gas-gangrene, then highly destructive on the Western Front, was permissible. Thousands are now dying of typhus in occupied Middle Europe, but if the censor has his way they cannot be saved by the dissemination of any new knowledge acquired here.

We detect no such narrowness of view in the few German medical and scientific publications that have reached this office since the attack on Pearl Harbor, nor in the pages of *Nature*, which is apparently permitted to exercise its discretion and which prints communications of the very type that have ben expunged from *Science*. The censor was certainly on slippery ground when he deleted references to indium because that metal can provide a satisfactory lining for shaving-cream and tooth-paste tubes. The Germans know as much about indium as we. So with the suppression of an item on a method of spraying walls of mines to prevent mercury poisoning. Some of the material to which the censor objected in the case of *Science* had been published in newspapers from Maine to California, so that nothing whatever was gained by deletion. To make matters worse, there is no appeal from this decision.

Probably Dr. Cattell is right in holding that the editors of scientific periodicals are better judges of what may or may not be of value to the enemy than technically incompetent postal authorities. If the policy to which he objects is carried out consistently, new scientific books and periodicals must be suppressed. Astrophysicists, biologists, plant and animal breeders, organic chemists who are trying to isolate vitamins and harmones, designers of new electron microscopes, inventors of materials that will resist fire, mathematicians who devise techniques that can be applied in solving the problems of designing engineers—all make discoveries that have some application in totalitarian war.

—*The New York Times.*

DISCOVERY OF DEPOSITS OF SODIUM SULPHATE AT DIDWANA

BY

H. B. DUNNICLIFF, C.I.E.
(*Chief Chemist, Central Revenues*)

WHEN the author was on a visit to Sambhar Lake in November 1940 in connection with an investigation into the possibility of exploiting the sodium sulphate and sodium carbonate deposits in the East Lake Bitterns Area,[1] the General Manager, Rajputana Salt Sources gave him a sample of 'pan scale' from Didwana, a salt source in Jodhpur State, about forty miles north-west of Sambhar.

'Pan scale', also called 'papri', is formed by the evaporation to dryness of the bitterns which remain after the manufacture of edible salt from subterranean brine at that place and it contains a high percentage of sulphate. When the General Manager received the analysis of this pan scale (Table I, Sample I) showing 85 per cent. of sodium sulphate, he expressed considerable surprise stating that the last reported analysis (*ibid.*, Sample II) in 1933 showed a much lower sulphate content and he suggested that another sample should be examined. The writer reported on this in January 1941 (Sample III) and expressed the view that this material might provide a good source of sodium sulphate for which there is a considerable and constant demand in India.

The matter was reported to the Central Board of Revenue and when Mr. R. K. Nehru, I.C.S., Collector, Central Excises and Salt, North-Western India, visited Didwana in the following March, he sent a number of samples of 'papri', collected from different pans, for analysis. These samples which varied very widely in sulphate content were mixed, the average analysis being shown in Table I, Sample IV.

TABLE I
Didwana Papri

	Sample I %	Sample II %	Sample III %	Sample IV %
Insolubles ..	0·27	2·80	0·56	3·14
Sodium chloride ..	13·05	69·38	19·26	65·04
Sodium sulphate ..	85·22	20·28	78·00	29·50
Sodium carbonate ..	0·70	6·78	0·58	0·35
Sodium bicarbonate	0·76	0·08	0·84	0·41
Undetermined and moisture ..	—	0·68	0·76	1·56

This very wide range of composition of papri or pan scale is not unusual, individual samples collected containing from 18 to 80 per cent. of sodium sulphate. This is explained by the method of formation of the papri which will be clearly understood from the description of Didwana salt manufacture given later, and the subsequent discussion.

The Collector proposed to ascertain if some industrial use could be found for papri of which, at the present scale of salt manufacture, about 15,000 to 20,000 maunds would be available annually. Mr. J. M. Saha, M.SC., C.R.C.S., Chemical Examiner, Central Excises and Salt, North-Western India, expressed the view that a salt having the composition of Sample No. IV, Table I, would be very suitable for curing hides and skins. The Collector asked him to submit a further report on the possibilities of Didwana papri and, with this object in view, he visited the Didwana Salt Works in May 1941.

Although by this visit Saha did not improve on his previous report on 'papri', he made a valuable contribution to India's industrial development in the discovery of a plentiful source of high grade, naturally occurring sodium sulphate and, in reconstructing its genesis, devised an improved method for the manufacture of high quality salt from Didwana brine.

Saha observed that the beds of the crystallising pans were formed of a thick crust of a very hard crystalline substance called "rohr" which was reported to be as much as three feet deep in some places.

Samples drawn from two different pans had the following composition.

TABLE II
Didwana Pan-bed Crust or 'Rohr'

	I (%)	II (%)
Inorganic insolubles	11·90	5·98
Organic insolubles	0·52	0·30
Sodium sulphate	82·74	93·17
Sodium chloride	4·50	0·40
Undetermined	0·34	0·15
Sodium sulphate on water soluble components	94·84	99·56

According to Saha's most recent calculations, over fifty lakh maunds and possibly a crore maunds of rohr are available for recovery.[2] About 3,000 tons of the rohr, very rich in anhydrous sodium sulphate, have recently been excavated from a few pans with a view to commercial exploitation, and Table III gives analyses of samples from different depths of a particular deposit.

TABLE III

Didwana Pan-bed Crust or "Rohr"

	Top sample %	Middle sample %	Bottom sample %
Insolubles	0·40	1·08	0·35
Sodium chloride	1·10	1·10	1·46
Sodium sulphate	98·11	97·50	97·50
Sodium carbonate ..	0·11	0·13	0·13
Sodium bicarbonate ..	0·11	0·21	0·34
Moisture	0·16	0·21	0·31
TOTAL ..	99·99	100·23	100·09

The Government of India are operating the Didwana Salt Works for the manufacture and sale of salt on lease under a treaty with the Jodhpur State to whom the area belongs, and the State is making arrangements for marketing this new and valuable source of salt cake.

PRESENT METHOD OF MANUFACTURE OF SALT AT DIDWANA

Salt has been manufactured at Didwana in Jodhpur State, Rajputana, from times immemorial. The salt source is an oval-shaped depression, about 4 miles long and 1½ miles broad, which generally remains dry, except for a short time during the annual monsoon.

The total area developed so far for the production of salt is 92 acres or less than 5 per cent. of the total available. Wells about 6 feet in diameter and 16 feet in depth are sunk in the depression. Kul (well) brine of unusually high density (Table IV) is found at a depth of about six feet from the surface and the supplies are said to be inexhaustible.

Round the wells, shallow evaporating pans are made of varying size and about one foot deep. Originally they had clay beds. The warm brine is taken from the wells by means of earthenware pots attached to the ends of lever lifts (chaunch).

The brine is run into the pans and is concentrated by solar evaporation and deposits salt, the multiple accretion system of manufacture being followed. The pans are charged to a depth of 1" to 2" with brine drawn from the wells. Evaporation and crystallisation take place and the pans are again charged, the same process being repeated until, after a few weeks, a thick crust of salt has been obtained. Much of the sulphate crystallises with the salt and naturally the quality of the product is poor [Table V, (*a*) and (*b*)]. Underneath this salt and in course of salt manufacture extending over many years, a hard crystal-

TABLE IV

Didwana 'Kul' (well) Brine

Density°, Be' / Temperature, °C.	26·9° / 37·5°C. %	26° / 39°C. %	25° / 39°C. %	24° / 39°C. %	23° / 37·5°C. %	20·9° / 37·5°C. %
Sodium chloride	22·99	19·53	18·49	18·27	16·05	16·97
Sodium sulphate	5·80	5·95	6·56	5·37	7·64	4·68
Sodium carbonate	0·51	0·87	0·42	1·04	0·48	0·62
Sodium bicarbonate	0·58	0·56	0·37	0·63	0·53	0·58
Total solids	29·88	26·91	25·84	25·31	24·70	22·85
Water	70·12	73·09	74·16	74·69	75·30	77·15
The above results expressed in terms of dry matter are given below.						
Sodium chloride	76·93	72·56	71·55	72·18	64·98	74·31
Sodium sulphate	19·41	22·11	25·39	21·21	30·93	20·44
Sodium carbonate	1·71	3·23	1·63	4·11	1·94	2·71
Sodium bicarbonate	1·95	2·10	1·43	2·50	2·15	2·54
	100·00	100·00	100·00	100·00	100·00	100·00
Percentage ratio of sulphate to chloride	25·23	30·52	35·49	29·42	47·61	27·51

crystalline bed of sodium sulphate has formed cumulatively on top of the clay bed.

The manufacturing season starts at the beginning of February and continues until the middle or end of May and sometimes even later. The mother liquor (bitterns) left in the pans after the extraction of salt subsequently dries and forms into a thick scale called 'papri' (v.s.). After each monsoon, it is only necessary to remove the mud and the papri from the pans and they are again ready for the manufacture of salt.

As ordinarily manufactured, Didwana salt is very dull and unattractive in appearance; the composition of two typical samples [Table V, (*a*) and (*b*)] indicate its poor quality, the principal contaminant being sodium sulphate.

TABLE V
Didwana Salt

	As manufactured by the usual process (%)		As manufactured by Saha's process (%) (*vide* below)	
	(*a*)	(*b*)	(*c*)	(*d*)
Insoluble matter ..	0·66	0·61	0·17	0·38
Sodium chloride ..	88·76	85·61	98·24	97·52
Sodium sulphate ..	9·45	12·79	0·85	1·40
Sodium carbonate..	0·27	0·11	0·05	0·21
Sodium bicarbonate	0·13	0·08	0·08	0·08
Moisture and undetermined ..	0·73	0·80	0·61	0·41

An examination of the composition of typical samples of brine from which the salt is manufactured (Table IV) will show that the indifferent quality of the salt made by the current method is not unexpected. The brines are of remarkably high density and the proportion of sodium sulphate to sodium chloride is very high, approximately 25 to 48 per cent.

SAHA'S THEORY OF THE FORMATION OF THE BED CRUST

On cold winter nights in February at the beginning of the annual manufacturing season, when the temperature of brine falls low, the solubility of the sodium sulphate falls sharply while that of the sodium chloride is not much affected. The solubility of the sodium sulphate is also further reduced by the presence of the sodium chloride so that, in cooling from over 80° F. (27° C.) to the cold weather temperature of about 36–40° F., sodium sulphate crystallises out as the decahydrate, Na_2SO_4, $10H_2O$ and deposits on the pan bed. This probably goes on night after night until the brine is sufficiently concentrated to deposit sodium chloride, by which time a large proportion of the sodium sulphate will have probably crystallised out. Saha thought that, up to a certain point, this separation of sulphate was specific, the hydrated salt losing water due to rise in temperature at a later stage. His conjecture was based on the composition of the samples of bed crust (rohr) which consist mainly of anhydrous sodium sulphate, remarkably free from the chloride and carbonates of sodium. The existing bed crust must have been formed by the sulphate thus separated only from the first few charges of brine fed into the pans each year. It has, therefore, taken generations to attain its present thickness. The sulphate separated in the later charges of the pans would deposit on the existing crystals of salt and thereby lower its purity.

LABORATORY EXPERIMENTS

Working on this theory of the formation of the bed crust, he conducted experiments at the Central Revenues Control Laboratory, New Delhi, on samples of impure brine brought from Didwana, which yielded very satisfactory results and confirmed the theoretical reasoning.

Using artificial refregeration, he showed that the separation of the sulphate and purification of the brine were most satisfactory at temperatures of from 36° F. to 42° F. The brine thus purified yielded samples of beautifully clear crystalline salt having as high a purity as 98 per cent. [*vide* Table V, (*c*) and (*d*)], while, from the crystalline Glauber's salt, anhydrous sodium sulphate separated when the laboratory temperature rose to summer heat.

On the results of these experiments, Saha proposed a scheme of manufacture calculated both to improve the quality of salt and to produce the valuable by-product, sodium sulphate, in commercial quantities. He suggested that the manufacturing season at Didwana should commence from the beginning of November and continue until February or March, *i.e.*, so long as the minimum night temperatures fell below 60° F. The method proposed that a certain number of pans to be called "eliminators" should be set apart for the separation of

sulphate, the resultant purification of the brine being assisted by natural agency of the low atmospheric night temperatures prevailing at Didwana. The eliminator pans, fully exposed to the cold atmosphere, should be charged to a depth of about 4 to 5 inches and, when the maximum amount of sulphate has separated but before the crystallisation of salt has commenced, the brine thus purified should be transferred in the early morning to a separate set of "crystallising pans" where, by the day-time heat and breezes, it would be evaporated for the manufacture of salt.

The separated decahydrate would be dehydrated before marketing.

Field Work at Didwana

Experiments on a large scale were next conducted at Didwana in the months of December and January, 1941–42, using specially selected existing pans and also pans newly constructed for the purpose. The author accompanied Saha on one of his visits and was much impressed with the success of his experiments, the only major difficulty encountered being that the temperature of the hot brine never fully fell to the lower atmospheric temperature anticipated. It was observed that the desired low temperatures actually occur at Didwana during November to February but, while the minimum temperature attained at one time was as low as 21·5° F., it usually varied between 32° and 40° F., while the brine temperature always remained about 15° F. higher than the minimum atmospheric temperature recorded. As a result of this and in spite of the very low range of atmospheric temperatures, the separation of sulphate and the purification of the brine were not so effective as Saha expected nor as complete as was promised by his laboratory experiments. He is of opinion that this is due to the fact that the natural temperature of the ground is high and that its radiation prevents the temperature of the brine from falling to the atmospheric level. In order to circumvent this difficulty, he has suggested that the eliminator as well as crystallising pans should be constructed on a special type of bed.

On the whole, however, the results obtained were very satisfactory and the process is undoubtedly workable and easy of operation even by the illiterate local salt manufacturers (deswals). Thus, apart from the discovery of this rich and plenteous source of sodium sulphate which should be sufficient to meet India's entire demand for some decades to come, the new method devised for the production of an improved quality of alimentary salt would simultaneously ensure the annual production of sodium sulphate on a large scale.

It has been found that, for every lakh maunds of salt produced, 15 to 20 thousand maunds of anhydrous sodium sulphate will be available. The average purity of the salt and the sulphate thus produced will be 97–98 and 97 per cent. respectively.

Saha's process has the great merit of simplicity in execution and in the words of the Collector "it kills several birds with one stone". A better quality of salt could be placed on the market, the season could be extended resulting in higher production and unemployment amongst the deswals would be relieved. Didwana would also increase in importance as a source of alimentary salt, the dependence on Sambhar for salt in the North of India being thereby considerably reduced and a valuable and much wanted industrial bye-product would be obtained in quantities. This annual supply of sodium sulphate would be supplementary to the rohr deposits mentioned earlier in the paper and the total output should satisfy India's entire demand for salt cake.

This scheme of salt manufacture will not interfere in any way with the normal recovery of the ordinary quality salt. This, as in current practice, should be started in February or March using the same pans after the winter manufacturing season is over. The deswals will thus remain employed for the greater part of the year to their great economic benefit.

The Theoretical Explanation of the Didwana Deposits and Saha's Process

Ignoring the small percentage of carbonates present, in terms of the phase rule, the simple system involved is $NaCl$-Na_2SO_4-H_2O and it is complicated only by the possible existence of the hydrates of sodium sulphate. Of these, the only one of any consequence is the decahydrate, Na_2SO_4, $10H_2O$.

The observed facts are explained as follows.

At the temperature of 37·5° C. at which the brine is drawn from the well, the solution is only rarely saturated with respect to the salts. It is usually unsaturated, though a study of the International Critical Tables will show that analysis No. 1 in Table IV practically corresponds with that of a saturated solution at the Na_2SO_4-NaCl transition point at 37·5° C., the hydrates of sodium sulphate being incapable of existence at that temperature.

The presence of sodium chloride has the effect of lowering the $Na_2SO_4, 10H_2O$—Na_2SO_4 transition point, the lowering being greater the higher the concentration of sodium chloride until a minimum transition point of 17·9° C. is reached, the transition point for the pure salt being 32·3° C. at atmospheric pressure.

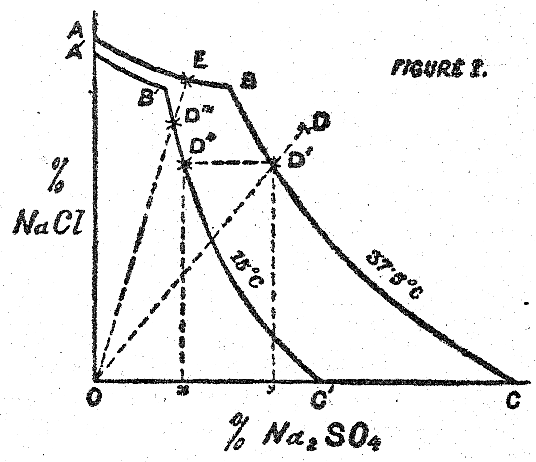
In the circumstances described, $Na_2SO_4, 10H_2O$ is likely to separate at temperatures of 20° C. (68° F.) and lower which prevail in the cooler weather.

While the solubility curve of the decahydrate is fairly steep (considerable increase of solubility with rise in temperature), the anhydrous salt has a "negative" solubility curve. The separation of the decahydrate from the solution effects a concentration of the liquid phase with respect to sodium chloride by removing from the solution water amounting to 1·27 times the weight of the sodium sulphate itself. This may involve the partial co-precipitation of some sodium chloride but, as will be observed from the brine analyses (Table IV), the ratio of sodium sulphate to sodium chloride is such that the sodium chloride can still stand some increase in its concentration owing to the removal of $Na_2SO_4, 10H_2O$ before its saturation point is reached. The tendency of the sodium chloride to separate is to some extent counterbalanced by the removal of sodium sulphate, the presence of which lowers the solubility of sodium chloride. The separation of the sodium chloride will thus be relatively small but the temperature range over which Glauber's salt crystallises out will be somewhat increased. It is of course possible that some anhydrous sodium sulphate will crystallise out from the hot brine but this is of no consequence because it would ultimately change to the hydrated salt in contact with the aqueous solution at the lower temperature.

The brine, partly denuded of its sodium sulphate at night and early morning cold weather temperatures in the eliminator pans, can now be run into the (salt) crystallising pans for solar concentration at higher temperatures. This rise in temperature permits a greater concentration of sodium sulphate in solution before becoming saturated with respect to it and results in the separation of a crust of sodium chloride reasonably free from sulphate, because the solubility of sodium chloride does not vary much with temperature and so will speedily come to saturation on simultaneous evaporation and rise in temperature.

These relationships are shown in Fig. 1 which is only diagrammatic. The presence of small quantities of the carbonates of sodium does not materially affect the system and has been ignored.

FIGURE 1.



A-B-C is the Na_2SO_4—NaCl solubility curve at 37·5° C. and A'-B'-C' is the corresponding solubility curve for 15° C.

For convenience, sodium sulphate is plotted in terms of Na_2SO_4 though the solid phase for the lower curve (15° C.) is the decahydrate, $Na_2SO_4, 10H_2O$.

Suppose the brine drawn from the well has the (unsaturated) concentration D. This will correspond with a point D' on the 37·5° C. saturation curve A-B-C. The solid phase in contact with this solution would be anhydrous sodium sulphate. Now imagine that this solution is cooled quickly to 15° C. Assuming that the concentration of the sodium chloride remains approximately the same, the corresponding point on the 15° C. curve would be D" and a considerable amount of sodium sulphate, corresponding with the difference in the concentration, y-x

on OC would have separated. But, at 15° C., this sodium sulphate which separates as decahydrate would actually have taken with it 1·27 times its weight of water and this would increase the concentration of the sodium chloride so that the composition of the liquid phase actually attained may be taken as D‴. On further concentration, Na_2SO_4, $10H_2O$ could separate until point B′ is attained but only cooling takes place in the eliminator pans and not solar evaporation. At D‴ therefore the brine is run off from the deposited Na_2SO_4, $10H_2O$ into the crystallising pans. Here the temperature rises and, on the Na_2SO_4-NaCl curve at 37·5°, the point attained (assuming no separation of solid phase to have taken place) will be E on the line joining O to D‴ and produced to cut the curve AB.

The effect of this is that the solid phase in equilibrium with the solution, abruptly changes from Na_2SO_4, $10H_2O$ to NaCl. Now solar evaporation can proceed, the concentration of the liquid phase increasing along the composition curve EB with deposition of sodium chloride until composition B is attained. At this point Na_2SO_4 would also separate. Before this happens, either more brine must be added from the eliminators or the mother liquor must be run away so that contamination of the salt crust may be obviated.

Formation of Rohr

In the process as practised for many generations, much decahydrate obviously separated at the bottoms of the pans. The temperature subsequently rose beyond that at which Na_2SO_4, $10H_2O$ can exist and this salt lost water and became converted into anhydrous salt, assisted by the presence of the sodium chloride. The anhydrous sodium sulphate was left at the bottom of the pan and the sodium chloride which may have been deposited with the Glauber's salt passed into solution and diffused into the supernatant brine eventually adding its quota to the salt crust. The finely divided sodium sulphate slowly changed into the larger crystals obtained on excavation at a later stage. This process continues adding its quota to the bed annually, and the high percentage of sodium sulphate in the rohr, contaminated by wind-borne dust and sand, is accounted for on a scientific basis.

Papri

After crystallisation is over and the salt removed, the residual mother liquor is left in the pans to dry out and is recovered as "pan scale" or "papri", *vide* Table I.

Theoretically, the proportion of sodium chloride and sulphate in "papri" should correspond with that in the liquid phase at the transition point at the final temperature attained but, owing to the conditions including variable temperatures under which the drying out occurs, such a theoretical composition for papri cannot be expected and the widely differing compositions recorded are not anomalous.

1. *Records of the Geological Survey of India* (in the press). 2. J. B. Auden, B. C. Gupta, P. C. Roy and Mehdi Hussain, *Rec. Geol. Surv. Ind.*, 1942, **77**, 36; 42.

OBITUARY

Prof. Richard Willstatter

Readers of *Current Science* will note with regret the death of Prof. Willstatter, one of the great masters of organic chemistry, on August 3, 1942, in Switzerland, a few days before his seventieth birthday, and three years after narrowly escaping a concentration camp when he was at Munich.

Starting with his brilliant work on alkaloids, he passed on to a variety of problems on catalysis, etc., and thence to intensive studies of natural colouring matters, principally chlorophyll, carotenes, and anthocyanins. The last phase of his work was another series of intensive investigations on the isolation, reactions and constitutions of enzymes, carried out with a brilliant band of collaborators. Willstatter was the first to develop the technique of selective adsorption in the preparation and separation enzymes. He was awarded the Nobel Prize in 1920.

EMBRYOLOGY OF ORCHIDACEÆ

BY

B. G. L. SWAMY

ORCHIDACEÆ comprising 450 genera and 7,500 species constitute a specialised group among angiosperms. In spite of their complex life-cycle only about 175 species (included under 75 genera) seem to have received the attention of morphologists, since the publication of the first available paper on the embryology of *Orchis* by Muller (1847). In the present article the author proposes to give a brief review of the scattered information on the embryological aspects of orchidaceous members.

Microsporogenesis and Male Gamete

Our knowledge concerning the microsporogenesis and the development of the male gametes is scanty and confined to the study of a few plants, and does not explain the organogeny of stamens, differentiation of parietal layers, tapetum, etc.

With the exception of *Paphiopedilum*, *Selenipedium* and *Cypripedium* most of the forms studied show only simultaneous divisions in the pollen mother-cell. In the three above-mentioned forms successive type has been noticed. In *Epidendrum raniferum* Hoffmann first suspected a successive type of development; but later confirmed it as a simultaneous type.

Details of the division of the uninucleate microspore into the tube and generative cells are incompletely understood. Recently investigations on the microsporogenesis of *Cymbidium* (Swamy, 1941) and *Eulophea* (Swamy, in press) have clarified many doubtful points. The nucleus of the microspore divides into an inner tube cell and an outer lenticular generative cell and a definite wall is laid down between them. After a time the separating wall disappears and gradually the plasma of the vegetative cell engulfs the tube nucleus which is surrounded by a small quantity of cytoplasm; ultimately the tube nucleus becomes spherical with a characteristic clear space around and comes to lie within the plasma of the vegetative cell. Such a type of "movement of the generative cell", as it is termed, has been reported in very few plants and it would be of great interest to discover if similar cases occur in other members of this family.

The mature pollinia of certain terrestrial orchids as *Orchis, Calanthe, Neottia, Calopogon*, etc., are in the form of small aggregates known as "massulæ" in contrast to almost all epiphytic forms where the entire pollen is massed up in the form of pollinia.

In most of the species the pollen is two-nucleate at the time of pollination. In *Cymbidium, Eulophea* and *Calopogon pulchellus* (Pace, 1909) the individual microspores of the quartet do not get separated, and germinate *in situ*. It is only in certain species of *Cypripedium* that they are seen to round off individually. The generative nucleus divides in the pollen tube into two male nuclei. The tube nucleus in *Cymbidium bicolor* exhibits a remarkable behaviour in that it elongates in the tube nearly ten times its original length before degenerating.

Zeuxine sulcata (Seshagiriah, 1941) exhibits some interesting peculiarities during the microspore formation. The "second mitotic division seems to be suppressed; hence 'dyads' of microspores are formed". These divide into vegetative and generative nuclei but such pollinia are not functional. In some pollinia the author reports the formation of abnormal spindles during the heterotypic nuclear division as a result of which supernumerary nuclei are formed.

Female Gametangium

The primary archesporium is subepidermal and single-celled, which directly functions as the megaspore mother-cell. Formation of the parietal layers is unknown in the family. Differentiation of two megaspore mother-cells which are either superposed or placed side by side, have been noticed occasionally in *Calopogon pulchellus* and species of *Cyprepedium* and in stray cases in *Gastrodia elata*. In *Calopogon pulchellus* some of the twin mother-cells were provided with individual covering of the nucellar epidermis. In *Oncidium prœtextum* (Afzelius, 1916) the terminal epidermal cell of the archesporium has the appearance of the embryo-sac mother-cell.

In *Gastrodia elata* the embryo-sac is organised even before pollination. In many terrestrial orchids, however, especially, the

group-Habernarieæ, the ovaries show only the archesporial initials at the time of pollination; and their further development is dependent upon pollination. In some of the epiphytic orchids (*Cymbidium, Dendrobium, Cottonia, Vanda,* etc.), the archesporial cell is differentiated in the nucellus only after pollination.*

TABLE I

Showing the Orchids that exhibit the Allium and Adoxa types of development of Embryo-Sacs

Plant	Author	Remarks
Allium-type		
Achreanthes monophyllus	Stenar (1937)	
Cymbidium bicolor	Swamy (1942)	
Cypripedium spectabile		
C. parviflorum	Pace (1907)	
C. pubescens		
C. candidum		
Epipactis latifolia	Vermoessen (1911)	Only sometimes
E. pubescens	Brown and Sharp (1911)	Only sometimes
Gyrostachys cernua	Pace (1914)	Only sometimes
G. gracilis		
Neottia nidus avis	Modilewski	
Orchis sambucinia	Afzelius (1916)	Very rarely
Oncidium prætextum		
Paphiopedilum insigne	” ”	
P. Leeanum		
P. spicerium		
P. barbatum	Francini (1930)	
P. villosum		
P. venustum		
Adoxa-type		
Bletia shepherdi	Sharp (1912)	Very occasionally
Epidendrum variegatum		
Epipactis pubescens	Brown and Sharp (1911)	Occasionally
Epipogon nutans	Swamy (unpublished)	
Gyrostachys cernua		
G. gracilis	Pace (1914)	Sometimes

In *Cymbidium bicolor* female archesporium is differentiated 3-4 days after pollination; in *Eulophea epidendrœa* in about a week's time and in certain species of *Vanda* after more than ten days. In *Dendrobium anosum* the megaspore mother-cell was observed to be in division 76 days after pollination.

FEMALE GAMETOPHYTE

Monosporic eight-nucleate Normal-Type is the predominant course of development of the embryo-sac. Orchids showing other types of development are listed in Table I. *Epipactis pubescens* and two species of *Gyrostachys* are very variable, showing both Bisporic and Tetrasporic types of development. This variability in *Epipactis pubescens*, "may be due", according to the authors (Brown and Sharp, 1911), "however, to some condition such as nutrition, which is external to the megaspores, and is probably not due to potentialities inherent in the various megaspore nuclei; ..... The most reasonable conclusion would seem to be that different courses of development are due to conditions external to the nuclei, and that the fate of the nucleus will depend on its position". Sharp (1912) who reports Adoxa type as of occasional occurrence in *Epidendrum* and *Bletia* also lays much stress on the position of the spindles at the first two divisions, as the determining factor in influencing the further course of development and his conclusion is in accordance with the one for *Epipactis*.

Among the orchids investigated, the megaspores of the linear tetrad show a difference in their individual sizes soon after their formation, the three micropylar ones being very much smaller than the chalazal one. The upper cell of the dyad in many instances remains without any further development. The chalazal megaspore by further development forms the mature embryo-sac. It may be mentioned here that Chodat (1913) in *Ophrys apifera* and *O. botteroni* finds sometimes that the two lowermost megaspores resolve into embryo-sacs.

Differences in the number of antipodals are of common occurrence, and are often exhibited in different ovules of one and the same ovary. The retardation or even the suppression of nuclear divisions at the antipodal end is often responsible for the development of 5-, 6- or 7-nucleate embryo-sacs. Fusion of the daughter nuclei following division of the antipodals at the chalazal

* Recent investigations have revealed that for the development of the female gametophyte, the transference of actual pollen on to the stigmatic surface is not necessary in certain species of orchids to initiate the development of the magasporanium but a mere application of the pollen extract in any suitable solvent on to the stigma does not only induce the enlargement of the gynostegium but also initiate the development of ovules and ovary. But it is obvious that no fertilisation takes place due to the absence of the male element. According to Laibach (1932) the orchid-pollen-substance is capable of streaching *Avena coleoptiles* and he is of the opinion that this active substance is related to the other growth-promoting auxins.

end which has been observed in *Gastrodia elata* (Kusano, 1915), *Cypripedium guttatum* (Prosonia, 1930), etc., ultimately results in an embryo-sac with less than eight nuclei According to Sharp (1912) the presence of 6-nucleate embryo-sacs in certain of the species investigated by him "seem to show a tendency towards a further reduction of the vegetative portion of the gametophyte".

The genus *Cypripedium* has raised a keen controversy in the orchid embryology. Pace (1907) studied four species of this genus in which she first described the "*Cypripedium*-type". According to her the lower dyad cell divides twice resulting in a pair of nuclei at each end of the embryo-sac. The upper pair constitutes the synergids; the lower forms the egg and the single polar nucleus. During the time of fertilisation one of the synergid nuclei descends down and takes part in the triple fusion with the second male nucleus. This was subjected to severe criticism by Rutgers (1923), who demanded a confirmation of Pace's work. Prosonia (1930) investigated *Cypripedium guttatum* and found the development to be very much similar to the Allium-type but with certain amount of reduction at the chalazal end of the embryo-sac, as a result of which 5- or 6-nucleate condition of the mature embryo-sacs arose. Francini's (1930) investigations on other species of *Cypripedium* corroborate Prosonia's findings. Carlson (1940) has re-investigated *Cypripedium parviflorum*. Unfortunately her work has not so far resulted in any substantial contribution to the megasporogenesis but she hopes to study the same in light of the previous work on the genius. According to her the mature embryo-sacs in the species studied by her contains 8 nuclei though "more evidence is required to settle this point".

In this connection the type of development in *Gastrodia elata* (Kusano, 1915) may also be considered. In this plant the chalazal megaspore of the tetrad develops into a mature embryo-sac of 4 nuclei; two synergids, one egg and one polar, similar in organisation to the one described by Pace for *Cyprepedium*. The author (Kusano, 1915) also found in *Gastrodia elata* at the time of fertilisation one synergid leaving its position and taking part in triple fusion. "Perhaps influenced by the work of Pace", as Schnarf remarks, Kusano reports the above condition; but in the opinion of the present author a reinvestigation of the form might reveal only a normal type of development, probably with reduced antipodal nuclei.

Fertilization and Endosperm

The time taken by the pollen tube from the time of pollination to actual entry into the embryo-sac is highly variable. The shortest period so far recorded is four days for *Gastrodia elata* (Kusano) and the longest in the case of *Vanda suavis* as observed by Guignard. Fertilization is strictly porogamous; double fertilization has been observed in most of the species investigated.

In the majority of forms examined, the development of endosperm proceeds upto the stage of triple fusion. Even this might be incomplete due to the fact that the polars remain just apposed and do not fuse.

The division of the secondary endosperm nucleus up to 2-3 divisions has been recorded so far only in five forms, *viz.*,

Cypripedium spectabile
C. parviflorum } (Pace, 1907).
C. pubescens

Paphiopedilum insigne
Chæmæorchis alpina } (Afzelius, 1916).

Sharp (1912) referring to the work of Pace on *Calopogon pulchellus* states that this plant is the only known case of endosperm formation among orchids. But a careful perusal of Pace's paper by the writer, however, revealed no such statement made by Pace herself about the endosperm. In fact only its stages upto double fertilisation have been described by her. In 1900 Nawaschin attributed the lack of endosperm to the failure of complete fusion of the polars or the second male nucleus. But Strasburger in the same year showed in several European orchids, that in spite of the complete fusion of the polar nuclei and the second male nucleus, endosperm did not develop. How it is that in this particular family the endosperm tissue is not seen in evidence, it is still difficult to determine.

Embryo

A most pronounced feature of the family is the undifferentiated embryo in the mature seed. The highest differentiation so far recorded is in *Sobralia macrantha* (Treub, 1879) where a clear differentiation into cotyledon and hypocotyl region is

observed and *Platyclinis* (Rendle, 1930) with a "terminal green cotyledon".

The zygote divides as a rule by a transverse wall; it is only in *Cymbidium bicolor* that the first wall may be sometimes laid down either vertically or obliquely to the long axis of the embryo-sac. A proembryo of a chain of three cells is formed, the terminal cell of which undergoes further divisions to form the actual embryonal mass. The basal cell usually develops into a suspensor whose shape and structure is most variable.

Complete lack of any suspensor has been noticed in *Epipactis pulstris, Listera ovata* (Fig. 2), *Cypripelium reginæ* and *Zeuxine sulcata*. In *Spathoglottis plicata* the uppermost cell of the proembryo towards the micropyle enlarges and sometimes grows out of the microplye; a similar case is reported by Treub (1879) in *Goodyera discolor* (Fig. 1). Very frequently in genera like *Orchis, Gymnadenia, Phajus*, etc., the suspensor consists of a single row of cells. In *Epidendrum ciliare* (Fig. 8) it is very long consisting of several tiers of cells, which are superposed. In several *Habenaria* species (Fig. 9) noticed by the writer (unpublished), the filamentous row of the suspensor cells grows out of the micropyle; and the terminal cell of the suspensor embeds itself in the placental tissue and acts like an aggressive haustorium. The suspensor in a number of cases sometimes branches profusely as in *Serapias lingua* (Fig. 7). In certain species of *Vanda*, the basal cell undergoes four vertical divisions resulting in the formation of eight cells which grow towards the chalaza and engulf the growing embryo (Fig. 5). In *Cymbidium* and *Eulophea* the succeeding few divisions of the zygote after its first transverse division are most irregular; one of the cells situated at the chalaza develops a filamentous row of cells, the terminal two or three cells towards the free end contributing to the actual embryo; the irregularly divided cells grow out and elongate in all directions inside the seed coat but do not reach any nutritive zones (Fig. 4). In *Stanhopea* also the development seems to be similar with some variations. In *Phalœnopsis grandiflora* (Fig. 3) the basal cell is divided by longitudinal walls to form a quadrant and each cell of the quadrant develops conspicuous copious tubular outgrowths which grow towards micropyle and chalaza.

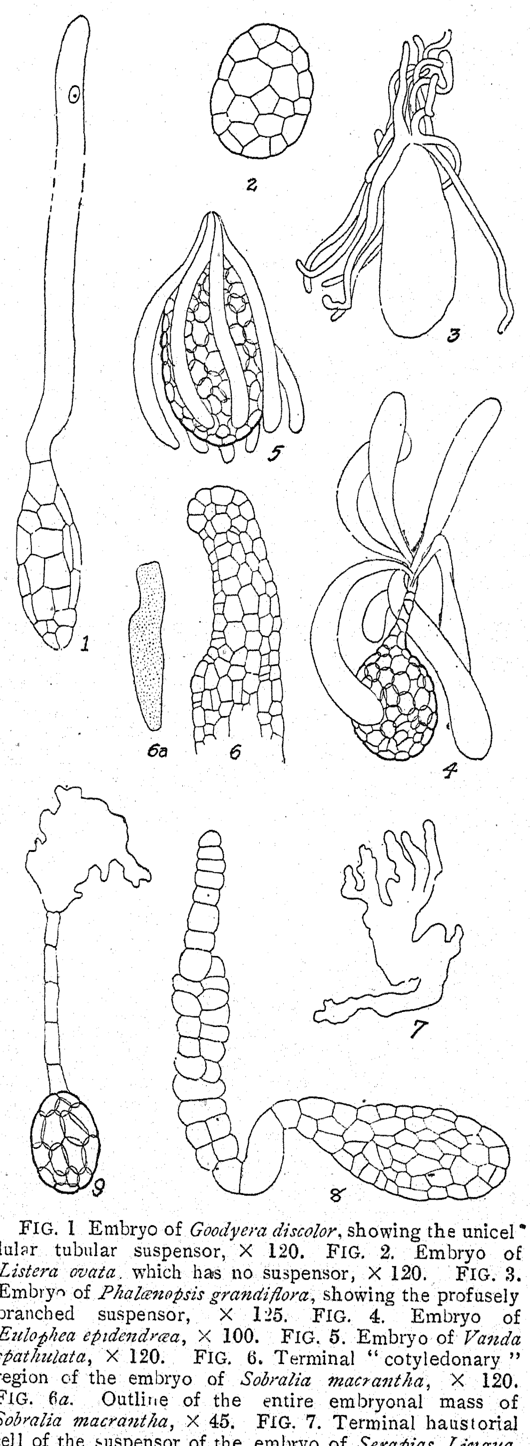


FIG. 1 Embryo of *Goodyera discolor*, showing the unicellular tubular suspensor, × 120. FIG. 2. Embryo of *Listera ovata*. which has no suspensor, × 120. FIG. 3. Embryo of *Phalænopsis grandiflora*, showing the profusely branched suspensor, × 125. FIG. 4. Embryo of *Eulophea epidendræa*, × 100. FIG. 5. Embryo of *Vanda spathulata*, × 120. FIG. 6. Terminal "cotyledonary" region of the embryo of *Sobralia macrantha*, × 120. FIG. 6a. Outline of the entire embryonal mass of *Sobralia macrantha*, × 45. FIG. 7. Terminal haustorial cell of the suspensor of the embryo of *Serapias Lingua*, × 85. FIG. 8. Embryo of *Epidendrum ciliare*, × 200. FIG. 9. Embryo of *Habenaria rariflora*, × 120. FIGS. 1, 2, 3, 6, 6a, 7 and 8, after Treub, 1879.

The function of such elaborately organised suspensor organ is not quite clear. Treub (1879) attributed the function of absorption of nutritive substances to this organ. In some instances, no doubt, they are definitely concerned with the absorption of nutrilites. As against this, in many cases their function as a haustorium has to be doubted. For instance, in many plants, they do not reach any nutritive tissues or possess rich cell contents. The nuclei in these, in fact, degenerate. Such being the case, we might have to modify the statement made by Coulter and Chamberlain (1903) (cited by Kusano, 1915) that "every suspensor is an Haustorium".

Polyembryony and Other Phenomena

Schnarf (1931) has listed a number of species in Orchidaceæ that exhibit more than one embryo in a single seed. In many cases the exact origin of the additional embryos has not been traced. In *Gastrodia elata* two embryo-sacs in the same ovule often develop to maturity, separate pollen tubes enter each of these and by further development after fertilisation normal diploid embryos are formed in one ovule. In the same plant, according to Kusano (1915), "at delayed fertilisation of the ovule the synergid tends to develop into an adventitious embryo. In this case fusion between the male and synergid nuclei is highly probable", in case of which the resulting embryo will be diploid (if Kusano's surmise is reliable), and "under a special condition the haploid egg may undergo the nuclear division leading to the generative parthenogenesis, but no cell division is ascertained", in which case the ensuing embryo will be haploid.

The occurrence and origin of haploid embryos in addition to nucellar ones has recently been recorded in *Zeuxine sulcata*. In this plant the megaspore mother-cell after the usual reduction divisions forms a lienar row of four megaspores; these upon undergoing anticlinal and periclinal divisions give rise to the haploid embryo.

Apomictic development associated with polyembryony (the origin of all the embryos being similar) is recorded in *Nigretella nigra* (Afzelius, 1928, 1932). In this plant the sexual development of the female gametophyte continues only till the four-nucleate stage. Even though the development of the pollinia is quite normal and functional fertilisation is not accomplished and all the embryos that arise are from the nucellar epidermis that caps the female archesporium. A very similar type has been described in *Zeuxine sulcata* but the pollen here is completely sterile.

In *Cymbidium* and *Eulophea* cleavage type of polyembryony is recorded and the resulting embryos are monozygotic. In *Cymbidium bicolor* sometimes the first wall laid down in the zygote will be vertical and under such circumstances in some cases the two cells develop independently and produce two embryos. In *Eulophea epidendracæa* (Swamy, in press) it is seen that any region of sexually produced embryo proliferates or buds off additional embryos.

Without entering into any discussion as to the cause of polyembryony, it may be stated that a large number of morphologists hold the view that sudden environmental changes might play an important part. Ernst (1918) on the other hand assumes that hybridisation as being the primary cause and nutritional disturbances as one of the probable causes in inducing polyembryony. The cause in *Zeuxine sulcata* "seems that this nutrative disturbance, just prior to the reproductory phase, may set up causes which bring about the phenomenon seen in" this plant, and the author (Seshagiriah, 1941) opines that "Nekrohormones" which are believed to bring about adventitious embryos in *Œnothera* may act in this particular case also.

(*Note.*—Only very important references are given here due to the scarcity of space.)

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LETTERS TO THE EDITOR

NOTE ON A PARTICULAR TEST FOR CONVERGENCE

If $\sum^{\infty} a_n$ is a series of positive terms, and if

$$\frac{a_n}{a_{n+1}} = 1 + \frac{f'(n)}{f(n)} + \frac{\rho_n}{f(n)}$$

where $f(x)$ is a continuous function such that $f''(x)$ tends to zero as x tends to infinity, then the series is convergent if $\underline{\lim}\ \rho_n > 0$, and divergent if $\overline{\lim}\ \rho_n < 0$.

In the proof of this result, Bromwich[1] works out and uses a peculiar form of the second mean value theorem, *viz.*,

$$f(n+1) = f(n) + f'(n) + \int_0^1 dx \int_0^x f''(n+t)\, dt.$$

But there is no need for this special form, and the proof will be rendered easier by using the familiar form, *viz.*,

$$f(n+1) = f(n) + f'(n) + \tfrac{1}{2} f''(n+\theta),\ 0<\theta<1.$$

V. S. Ananthachar.

Mysore,
December 12, 1942.

1. Bromwich, *Infinite Series*, 1926, p. 39.

THE OPEN-ARC METHOD OF EXCITING THE BALMER SERIES

When a steady stream of hydrogen is passed into a copper arc the Balmer series of lines is excited. The series is also obtained if instead of hydrogen, a stream of coal-gas or steam is used. In fact, with steam more lines of the series appear and their intensity is even greater than with hydrogen. In all these cases, however, the lines are very broad compared to what are obtained with an ordinary discharge tube. A series of experiments with different metallic arcs run at various current strengths brought out two significant facts: (*i*) The Balmer series is excited only with the copper arc and no trace of the series is to be observed with iron, zinc, aluminium or carbon arcs. (*ii*) Along with the hydrogen lines, the OH Bands $^2\Sigma \rightleftharpoons {}^2\Pi$ at $\lambda\lambda$ 3064 and 2811, also appear and as regards occurrence and intensity these bands and the Balmer series of lines go *pari passu*.

That the excitation of the hydrogen lines is not a pure temperature phenomenon becomes obvious. Two explanations suggest themselves. First, in the case of the arcs where the hydrogen lines are not excited, the hydrogen supplied is used up in reducing the oxides of the electrodes formed. With copper arc, copper being less easily oxidised, a free supply of hydrogen becomes available for excitation. Second, and what seems more plausible, the excitation of the hydrogen atom is due to some collision processes taking place in the copper arc.

In the case of copper it is well known that the electronic configuration $3d^{10}\ 4s$, gives the series of normal doublet levels, while the configuration $3d^9\ 4s^2$ gives a system of inverted doublet and quartet levels. Some of these latter levels lie in the continuum above the limit of the level $3d^{10}\ {}^1S_0$. If an excited copper atom in one of these levels makes an inelastic collision with a hydrogen atom and comes down to the level ${}^1S_0$, the energy so liberated may be sufficient to raise the hydrogen atom from the second to the higher orbits thus giving rise to the Balmer series. Alternatively, a collision between a copper atom

in the $3d^9$ $4s$ level and a hydrogen atom may result in bringing the copper atom to the $3d^{10}$ level and exciting the hydrogen atom to higher levels.

It is also observed that the injection of steam or hydrogen greatly modifies the intensity of a number of copper lines, especially in the region below λ 3000. A detailed analysis of the lines which are so modified will give a clue to the nature of the collision processes involved in the arc.

A. S. GANESAN.

College of Science,
Nagpur,
January 1, 1943.

GEL-FORMATION BY MUTUAL INTERACTION OF OPPOSITELY CHARGED SOLS

A STUDY of the literature reveals that most of the inorganic gels have been prepared by the following two methods:

(*i*) Metathetical reaction: In this method solutions of definite concentrations of substances which on reacting give rise to the gel-forming substance, are mixed in suitable proportions. The resultant mixture is clear in some cases (silicic acid)[1] while in others[2,3] a precipitate is obtained which disappears on slight or vigorous shaking.

(*ii*) Addition of an electrolyte to a sol: In this case certain electrolytes of suitable concentration are added to a fairly concentrated sol of the gel-forming substance, dialysed to a certain extent.[4]

However, other methods, such as the action of α-, β- and X-rays on a sol (Fernau and Pauli),[5] addition of non-electrolytes to a sol (Freundlich),[6] dilution of a true solution of a gel-forming substance (Prasad and Desai),[3] have been used in particular cases.

The authors have discovered that transparent or translucent gels are formed when oppositely charged sols of suitable concentrations, dialysed and undialysed, are mixed together in proper proportions. So far as the authors are aware it has always been observed that mutual coagulation takes place when oppositely charged sols are mixed together in proper proportions. The formation of gels by mixing oppositely charged sols seems to be a new observation. The first observations were made on mixing the sol of nickel hydroxide (negatively charged) with sols of ferric and aluminium hydroxide (positively charged). The nickel hydroxide sol was prepared by shaking with distilled water the gel obtained by the addition of NaOH solution to a saturated solution of nickel hydroxide in tartaric acid and its colloidal content corresponded to 3·01 g. of nickel per litre of the sol. The ferric and aluminium hydroxide sols were prepared by the hydrolysis of ferric chloride and aluminium acetate, respectively, and their colloidal contents were found to correspond to 3·05 g. of Fe_2O_3 and 2·34 g. of Al_2O_3, respectively, per litre of the sols. Gels were obtained when 5 c.c. of the nickel hydroxide sol were mixed with the following volumes of the ferric hydroxide sol dialysed to different extent.

TABLE I

Days of dialysis	Volume limits
0	1·30—1·55 c.c.
1	1·70 - 2·40 ,,
2	2·35—3·05 ,,
3	3·50—4·20 ,,
4	5·30 - 5·80 ,,
5	5·25 - 6·75 ,,

Gels have now been obtained on mixing (*i*) the sol of aluminium hydroxide (+ve) with sols of manganese dioxide (—ve), antimony sulphide (—ve) and silicic acid (—ve), and (*ii*) the sols of ferric hydroxide (—ve) and silicic acid (+ve).

MATA PRASAD.
S. D. MEHTA.

Chemical Laboratories,
Royal Institute of Science,
Bombay,
December 29, 1942.

1. Prasad and Hattiangadi, *J. Indian Chem. Soc.*, 1929, **6**, 653. 2. Prakash and Dhar, *Ibid.*, 1929, **6**, 587; 1930, **7**, 367. 3. Prasad and Desai, *J. Univ. Bom.*, 1938, **7**, 132. 4. Freundlich and Leonhardt, *Koll. Beih.*, 1915, **7**, 195; Weiser, *J. Phys. Chem.*, 1922, **26**, 418, 681; Schleck and Szegvari, *Koll. Z.*, 1932, **60**, 1847; Prakash, *Koll. Z.*, 1932, **60**, 184; *J. Indian Chem. Soc.* 1932, **9**, 193. 5. Fernau and Pauli, *Koll. Z.*, 1917, **20**, 20. 6. Freundlich, *Ibid.*, 1928, **45**, 348.

PARACHORS AND MOLECULAR DIAMETERS

THE mean value of $\frac{[P]}{V_0}$ is 2·873,[1] where [P] is the parachor and V_0 is the zero volume at absolute zero. At absolute zero, parachor can be written as

$$[P] = \frac{M}{D_0 - d_0}\gamma_0{}^{1/4} = V_0\,\gamma_0{}^{1/4},$$

all the terms involved having their usual significance.

So, $\frac{[P]}{V_0} = \gamma_0{}^{1/4} = 2\cdot873$. Hence, $\gamma_0 = 68\cdot2$ for a majority of substances. However, it has been observed that γ_0 varies between 60 and 80 for many organic substances.[2] But, for purposes to be described below, the value of γ_0 may be taken as a constant for all normal substances.

The following equation[3] gives a relation between density and temperature;

$$D_0 = \frac{D - d}{(1 - T_r)^{3/10}}.$$

Since $V_0 = \frac{[P]}{2\cdot873} = \frac{M}{D_0}$, $D_0 = \frac{M.\,2\cdot873}{[P]}$.

Temp.	Benzene		Chlorobenzene		Carbon tetrachloride	
	σ_v	σ_p	σ_v	σ_p	σ_v	σ_p
0° C. ..	5·87 × 10^{-8} cm.	5·89 × 10^{-8} cm.	6·15 × 10^{-8} cm.	6·17 × 10^{-8} cm.	6·03 × 10^{-8} cm.	6·03 × 10^{-8} cm.
40 ..	5·97	5·97	6·23	6·24	6·13	6·12
80 ..	6·08	6·08	6·32	6·33	6·25	6·23
120 ..	6·21	6·21	6·42	6·42	6·39	6·37
160 ..	6·38	6·37	6·53	6·54	6·57	6·55
200 ..	6·63	6·62	6·68	6·69	6·85	6·81

Hence, neglecting d which is usually small and rewriting,

$$[P]\cdot\frac{D}{M} = 2\cdot873\,(1 - T_r)^{3/10} \text{ or}$$

$$[P]/V = 2\cdot873\,(1 - T_r)^{3/10},$$

where V is the molecular volume.

This relation between molecular volume and parachor is useful in calculating molecular diameters of substances at any temperature. The above expression gives

$$V = \frac{[P]}{2\cdot873\,(1 - T_r)^{3/10}}.$$

If molecules are assumed to be elastic spheres closely packed together, it is calculated that

$$\sigma = 1\cdot326\times10^{-8}\,\sqrt[3]{V}\text{ cm.,} \qquad \text{(i)}$$

where σ is the molecular diameter. Substituting for V in (i),

$$\sigma = 1\cdot326\times10^{-8}\sqrt[3]{\frac{[P]}{2\cdot873\,(1 - T_r)^{1/10}}}\text{ cm.}$$

$$= 0\cdot933\times10^{-8}\,\frac{[P]^{1/3}}{(1 - T_r)^{1/10}}\text{ cm.} \qquad \text{(ii)}$$

It may be remarked that if γ_0 varies between 60 and 80 (see reference 2), the values of γ_0 under extreme cases, may be taken as $68\cdot2\pm12$. Since the value of γ_0 employed in deducing equation (ii) is the reciprocal of the 12th root, the maximum possible error in calculating the value of σ would be 1·5%.

In the above table, the values of molecular diameters for three substances at six different temperatures are calculated by both the equations (i) and (ii). The values of σ_v are obtained by equation (i), from $V = M/D$ where M is the molecular weight and D is the density of the liquid. Density data at various temperatures are taken from Sugden's paper 4; σ_p is calculated by equation (ii).

The good agreement between the two sets of values of molecular diameters of non-associated liquids is a proof regarding the validity of the equation (ii) proposed for calculating molecular diameters in normal liquids, over a wide range of temperatures. Strictly speaking, the values of σ represent the upper limits of the average distances between the centres of adjacent molecules in the liquid state.

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Department of Chemistry,
Ramnarain Ruia College,
Matunga, Bombay 19,
December 12, 1942.

1. Sugden, *J. Chem. Soc.*, 1927, p. 1783. 2. Sugden, *Ibid.*, 1784. 3. Sugden, *Ibid.*, 1781. 4. Sugden, *Ibid.*, 1782.

VITAMINS, MINERALS, CARBOHYDRATES AND PROTEINS IN FRUITS—II

THE amount of minerals such as calcium and phosphorus and of vitamins that take part in human metabolism are not large. Therefore one may look for a supply of these essentials in fruits though in small quantities, but in the *soluble form*. In the investigation presented here we have analysed ten fruits for protein, sugars, calcium, phosphorus, vitamin B_1 and in some, vitamin C. Water and trichloracetic acid extracts and ash of the fruits were examined for soluble and insoluble constituents.

Detailed estimations of carbohydrates are published elsewhere.[1] Brigg's colorimetric method for phosphorus, McCrudden's volumetric method for calcium and Kjeldhal's method for protein were adopted. For vitamins C and B_1 the water extract of fruit was taken. For the estimation of vitamin C dichlorophenol-indophenol method[2] was adopted. In the case of vitamin B_1 the quantity of water used for extraction was kept large. The extract was clarified with the minimum quantity of basic lead acetate and sulphuric acid and was then treated with norite. Pure vitamin was retained by norite which was later on released by acidulated water and estimated by using thiochrome method by H. Tauber.[3] Details will be published elsewhere.

All fruits contain sugars and some have starch in addition. Sugars present are mainly glucose and fructose. The concentration of phosphorus from water and acid extracts and from ash is same and is in ortho condition. Same is true with calcium except in sapota

Analysis of 100 gm. of Fruit

Common Name	Botanical Name	Proteins gm.	Sugars gm.	Phosphorus gm.	Calcium gm.	Vitamin B_1 mgm.	Vitamin C mgm.
1. Chiku	*Sapota zapolilla*	0·938	9·21	0·012	0·019	0·078	
2. Orange	*Citrus aurantium*	0·628	8·31	0·013	0·013	0·108	53·5
3. Figs	*Ficus carica*	1·114	9·07	0·024	0·052	0·042	
4. Guava	*Psidium guyava*	1·39	9·44	0·028	0·109	0·045	
5. Plantain—Velchi ..	*Musa sapientum*	1·15	18·33	0·032	0·003	0·138	0·82
6. Plantain—Green Skin	,, ,,	1·07	17·83	0·039	0·003	0·132	
7. Plantain—Rasbali .	,, ,,	1·11	18·07	0·027	0·006	0·126	
8. Apple Red ..	*Pyrus malas*	0·25	10·48	0·022	0·007	0·099	1·08
9. Apple—Yellow green	,, ,,	0·242	10·50	0·022	0·007	0·090	1·24
10. Grapes—Yellow ..	*Vitis vinefera*	0·54	14·69	0·016	0·24	0·036	

which has 30 per cent. water-insoluble (acid-soluble) when analysed with skin on, the rest being water-soluble. The amounts of vitamins present are fairly high especially B_1 in plantain, apple and sapota.

N. D. Rege.
S. C. Devadatta.

Wilson College,
Bombay,
November 26, 1942.

1. Rege and Devadatta, *J. Univ. Bomb.*, 1941 **10, 3,** B, 74. 2. *Nature*, 1933, **15,** 132. 3. Tauber, H., *Mickrochem. Actà*, 1938, 108.

A CHROMATOGRAPHIC ADSORPTION METHOD FOR THE ESTIMATION OF THE PROVITAMIN A CONTENT OF FOODSTUFFS

Recent work[1] from this laboratory has shown that the petroleum ether-methyl alcohol phase partition for the separation of carotene from xanthophyll is unsatisfactory because some coloured but biologically inactive degradation products also remain in the epiphasic layer and are, therefore, estimated as carotene. Errors due to the presence of such non-carotene pigments have been found to be rather high in the case of stored foodstuffs like cereals, pulses and condiments. Further, the inactive isomer, lycopene, is likely to be estimated as carotene while no account is taken of the fact that β-carotene is biologically twice as potent as any of the other pro-vitamins A. A correct estimation of the vitamin A activity of any vegetable material can be made only by determining the amounts of the different provitamins present and employing the formula: Vitamin A activity in International Units =

$$\frac{\mu g \text{ of } \beta\text{-carotene}}{0\cdot 6} + \frac{\mu g \text{ of other provitamins}}{1\cdot 2}.$$

Chromatographic adsorption which offers the only means of separating these pigment mixtures has not been used as a routine method of estimation since the pigments may be lost to the extent of 10 to 20 per cent. due to incomplete elution from the adsorbent. However, by the application of the chromatographic adsorption in two stages and by a choice of suitable adsorbents, it has been possible to estimate firstly, the total carotene (including lycopene, if present, but no artifacts) and then the relative proportions of the constituent pigments. After repeated trials with a number of substances, dicalcium phosphate prepared according to Moore[2] was found to be satisfactory for the first chromatography. Xanthophylls and artifacts are strongly adsorbed by it, while carotene and lycopene pass down practically unadsorbed. Cryptoxanthin is only weakly adsorbed and, therefore, it can be collected sepaartely by further developing the chromatogram. Recovery experiments with pure β-carotene solutions have shown that the losses are never more than 2 per cent. with a properly prepared adsorbent column.

The carotene solution thus obtained is concentrated to a small volume and chromatographed over a column of Brockmann's alumina. The bands are eluted separately and the different pigments identified and their concentrations determined. The eluates may account for a recovery of about 85 per cent. only but since the three common hydrocarbon pigments—β-carotene, α-carotene and lycopene—differ very slightly in their adsorbabilities, it may be reasonably assumed that the losses would be proportionate. Using this proportion the quantities of the individual pigments present in the original carotene extract (first chromatography) are calculated.

A number of foodstuffs have been assayed for their provitamin A content employing the extraction procedure described in an earlier paper[3] in conjunction with the adsorption technique described above. All the estimations were on petroleum ether (b.p. 60-75° C.) solutions, taking readings at three wavelengths (450, 470 and 480 $m\mu$) in a visual spectrophotometer and employing extinction coefficients derived from a sample of pure β-carotene isolated from Badami mango fruit.[4]

Provitamin A content in 100 grams of material

Name of the Material	Health Bulletin (1 μg = 1 I.U.)	By the authors: Phase partition method μg. "Carotene"	Chromatographic method μg. "Carotene"	Composition of the "Carotene" (per cent.)	Vitamin A activity in Int. Units (Calculated)
Papaya fruit ..	2020	—	1280	C 90; β–10	1170
Coriander seeds ..	1570	230	100	L 55; β–45	73
Dry chillies ..	576	11200	6230	β–71; α–26	8820
Gingelly seeds ..	100	21·0	12·0	—	<20
Whole wheat ..	108	21·0	(?) 6·0	—	<10
Horse gram ..	119	74	16	Mostly β–	27
Mace ..	—	3580	2150	L(?) 92; β–8	290
Fenugreek seeds ..	160	660	260	β–92; ? 8	420

L = lycopene; C = cryptoxanthin; α– = α–carotene; β– = β–carotene
? = doubtful identity.

A few typical results are presented in the above table. For the sake of comparison, values for the carotene content given in Health Bulletin No. 23 (Third Edition) of the Government of India, are also included in the table; these are mostly obtained from the work of De and co-workers.[5] The figures clearly show that, apart from varietal differences and individual variations, a large proportion of the pigment present in stored foodstuffs and estimated as carotene by the phase separation method may be actually of a non-carotene nature. Further, the results indicate the need for a thorough re-investigation of the common food materials employing these improved methods.

Finally, a word of caution is necessary with regard to the first chromatography. There are many variables in the experimental procedure —the adsorptive power and particle size of the dicalcium phosphate, size of the column and the method of packing, vacuum applied for packing and during the experiment, etc.,— and unless special care is taken, considerable errors may be introduced into the determinations. At the outset, all these experimental conditions should be standardised to give quantitative recoveries of carotene and the details strictly adhered to subsequently. It is further recommended that each lot of adsorbent be tested to give a proper performance before making use of it for estimations.

In the case of leafy vegetables and similar rich sources, saponification of the pigment extract may be omitted but it is essential in the case of poorer materials since the presence of more than 25 mg. of oil in the extract interferes with the adsorption of some of the non-carotene pigments while more than 150 mg. of oil is definitely objectionable.

Full details of the method and analytical data on the provitamin A content of a number of foodstuffs under investigation, will be published elsewhere.

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S. D. Rao.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
January 8, 1943.

1. Ramasarma, G. B., and Hakim, D. N., *Nature*, 1942, **149**, 611; *Ann. Biochem. Exp. Med.*, 1942, **2**, 181. 2. Moore, L. A., *Ind. Eng. Chem.*, *Anal. Ed.*, 1940, **12**, 726. 3. Ramasarma, G. B., *Ann. Biochem. Exp. Med.*, 1942, **2**, 103. 4. Ramasarma, G. B., Rao, S. D., and Hakim, D. N. (Unpublished data). 5. De, N. K. and coworkers, A number of papers in *Indian J. Med. Research*, 1935–38.

THE EFFECT OF NUTRITION AND CLIMATE ON RAT LEPROSY

Clinical experience of leprosy has given a universal impression all over the world that it is a "poverty disease". It means that more than infection predisposition is a more vital factor and this lies in some defective nutrition. To solve this mystery attempts have been made and are still being continued to trace the nutritive factor to some vitamin deficiency particularly to that of vitamin A. Apart from this, regional distribution of leprosy has been well recognised as an unsolved problem. There may be a village where leprosy incidence may be ten per hundred or even more whereas in the whole geographical province where food and race are not apparently different it may not be more than ten in a thousand of population.

Unfortunately no laboratory animal has data on the provitamin A content of a

leprosy so that no experiments could have been undertaken to show a connection between its nutritive and infective factors. But rats suffer from a leprosy of their own upon which again no experiments have been reported to show a nutritive basis of predisposition or a regional factor leading to infection.

About half a dozen rats were obtained through the kindness of Dr. Lowe in Calcutta which had been infected with rat leprosy over seven months previously. One of these rats was used for infecting a batch of white rats kept in the animal house of the Osmania Medical College in Hyderabad. The rats were given a very simple diet; Bengal gram soaked overnight in water and fresh lucern; of those two items they got as much as they could eat. Along with the rats some rabbits and Belgian hares were also kept and given the same diet. The food and the climate did not prove congenial at least to the rabbits, for within eighteen months these animals developed a very infectious skin disease and had to be destroyed on that account. The rats, on the contrary, did not show any sign of skin trouble.

Twenty rats were selected, all about a year in age. Ten of them got an emulsion of rat leprosy tumour where each drop was teaming with germs; of a total dose of one c.c., half a c.c. was injected intraperitoneally and the rest subcutaneously. Another ten rats got a total dose of half c.c. again injected intraperitoneally and subcutaneously. Of these twenty rats, six died within ten days and the rest that survived got one and all tumours on the skin at the site where they were injected subcutaneously after seven months. Internal organs were also affected whenever they were examined. This experiment gave results typical of rat leprosy and needs no further comment.

As I also work for some months at the Indian Institute of Science, Bangalore, I took two rats originally sent by Dr. Lowe and they were sacrificed to give an emulsion with which 14 rats were infected. Ten of them got a total dose of 1 c.c. injected, as in the case of Hyderabad batch of rats, in two places, intraperitoneally and subcutaneously and the rest, namely, four rats, got a total dose of only half a c.c. The actual operation of injection was done by my friend, Dr. Naidu, of the Serum Institute, and was carried out in his laboratory at Hebbal. After the animals were injected they were brought over to the Animal House of the Biochemical Department of the Indian Institute of Science, where they were kept on the well-known MacCarison diet, comprising of wheat flour, fat and salts. It is the diet used at the Nutrition Research Institute, Coonoor, and is rich in vitamins and has proved the best for breeding rats. Even after eighteen months the rats kept at Bangalore showed no sign of any disease and fortunately none had died. Subsequently they were used by other workers for a different experiment as though they had been perfectly healthy. It is very difficult to interpret this finding. The animals were infected from material that was microscopically controlled and found to be highly infective; the actual operation was carried out by an expert veterinary surgeon; and they were kept in an animal house of an all-India famous Institute.

Dr. De, the pharmacologist at the Indian Institute of Science, kindly infected another batch of rats and Prof. V. Subrahmanyan had been good enough to allow me to repeat the experiment. This experiment also gave similar results so that it is evident there is a great difference in the food and climate as effecting leprosy rats in Hyderabad and those kept at Bangalore. Judging from the health of the rabbits upon the same diet as given to the rats there is no doubt that the animals at Hyderabad were very badly off.

A preliminary report is a very dangerous one in so far as it appears exciting and even promising but has no value unless it is confirmed and it is here that the co-operation of others is required. I have taken all care to claim nothing which is not due to me and as the experiments take a long time to carry out it is advisable that others interested in leprosy might try to confirm or contradict the above finding. The findings above do not allow of any other interpretation than that mentioned above, so that if confirmed, would only bear out what has been believed but not proved so far, namely, that good food and favourable climate both acting together make man immune to leprosy.

The Osmania University had kindly sanctioned some funds for research on leprosy and I beg to thank the authorities for their kindness. It is hoped that these experiments would be extended.

S. Mahdihassan.

Osmania Medical College,
Hyderabad (Dn.),
December 14, 1942.

ESTROGEN THERAPY OF THE INDIAN CRESS OIL

Indian *cress* (*Lepidium sativum* Linn.), a familiar shrub belonging to the N.O. cruciferæ, figures very prominently in the Indian materia medica. Among the various medicinal virtues ascribed to this seed, the chief are its galactagogue and enenagogue properties. In certain parts of India sweet balls prepared from these seeds are still used as a special tonic after delivery.

A detailed study of the pharmacological action of the active principles of the seed has been undertaken by us. The proximate analysis of the seed gives moisture 5·69 per cent., ash 5·7 per cent., crude protein 23·5 per cent., crude fat 15·91 per cent., P_2O_5 1·65 per cent., calcium 0·31 per cent., and sulphur 0·9 per cent.

The seed on steam distillation yielded a volatile oil having a characteristic pungent smell. In 1874 Hoffman obtained this volatile oil on steam distillation. The seed also yields about 5 per cent. mucilaginous matter. In addition to the volatile oil and mucilaginous matter the seed also contains 0·19 per cent. of alkaloid.

Estrogen therapy.—A group of immature female rats (30 days) were kept on the following diet:—

Sugar 10, casein 14, butter 15, Osbourne Mandell salt mixture 5, and rice flour 56 parts. The diet was supplemented by ½ tablet of yeast and 2-3 drops of cod-liver oil per day per rat.

The experimental rats received 3-4 drops of the cress oil in addition to the above diet, whereas the control rats received only the above diet. All the rats were killed on the 72nd day, having received the oil for six weeks. The ovary, thyroid and thymus glands were removed and weighed.

The ovaries of the experimental rats weighed consistently more than that of the control rats. The average weight of the ovaries from the experimental rats was 0·45 gm. per Kg. body weight, whereas that of the control rats was 0·25 gm. per Kg. body weight. Macroscopic examination of the ovaries of the rats receiving the oil was very significant and exhibited several hæmorrhagic follicles on the surface. No such characteristics were observed on the ovaries from control series. The uterus, thymus, thyroid and other organs did not show any abnormality. The results along with the details of histological examination will be reported later.

There was no significant difference in growth rates of the rats. The rats receiving the oil weighed comparatively less (average 83 g.) than the control ones (average 88 g.) but were significantly more active than the control series.

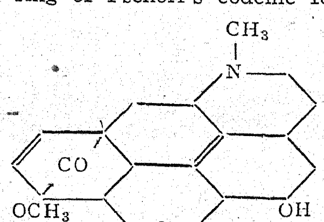
Thanks are due to Dr. V. Subrahmanyan for his keen interest.

M. B. Sahasrabuddhe.
N. N. De.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
December 9, 1942.

A SEARCH FOR PORPHYROXINE IN BENGAL OPIUM

Porphyroxine $C_{19}H_{22}O_4N$ was isolated[1] by Rakshit from the Indian variety of *Papaver somniferum* L. He represented[2] the base as a derivative of a tetrahydro codeine with the carbonyl group in a bridge position in the aromatic ring of Pschorr's codeine formula:



Porphyroxine

Later, Machiguchi[3] isolated from Japanese opium, an identical product which, however, proved to be a mixture of codamine, laudanine and meconidine. Recently[4] the view has been expressed that the constitution proposed for porphyroxine can only be accepted with reserve. It was, therefore, considered necessary to re-investigate the occurrence of porphyroxine in Bengal opium, a specimen of which was purchased as a dry powder from the Government opium factory at Ghazipore.

Following Rakshit's method[1] the total water-soluble non-phenolic bases were isolated by ether-extraction of a lime-water extract of opium. Further treatment of the crude bases with dilute hydrochloric acid gave a sparingly soluble hydrochloride (A) in an yield of about 0·34 per cent. The same hydrochloride (m.p. 265°-269° d., after a slight darkening at 240° C.) was prepared in an yield of 2·6 per cent. by extracting the total alkaloids of opium with chloroform and subsequent treatment of the alcoholic solution of the bases with dilute hydrochloric acid. On recrystallisation from alcohol the hydrochloride (A) in colourless needles melted at 276°-277° c.d. after sintering at 270° C. The free base corresponding to this was crystallised from alcohol in colourless rectangular rods. (M.P. = 152°-153° C., unchanged on mixing with a genuine specimen of codeine for which the author is deeply indebted to Prof. B. B. Dey.)

The above yield of codeine from Bengal opium is much higher than Rakshit's estimate,[5] but agrees well with that of Annet[6] and Dunnicliff.[7]

Attempts to isolate porphyroxine from the mother-liquors of codeine hydrochloride have so far proved fruitless. Only a more intensive search can finally settle the possibility that Rakshit's porphyroxine might be an impure specimen of codeine.

As the author is at present unable to continue this work, owing to other preoccupations, he leaves this question to be settled by others interested in the subject.

The author is highly grateful to Prof. L. F. Small for suggesting this problem, and to Mr. J. N. Rakshit and Col. S. S. Sokhey for their kind interest.

S. Rajagopalan.

Haffkine Institute,
Bombay,
December 28, 1942.

1. Rakshit, *J.C.S.*, 1919, **115**, 455. 2. Rakshit, *Ber.*, 1926, **59**, 2473. 3. Machiguchi, *J. Pharm. Soc. Japan*, 1926, **592**, 19. 4. Small, "Chemistry of the Opium Alkaloids," 1932, p. 308. 5. Rakshit, *Analyst*, 1921, **46**, 485; *Ind. J. Pharm.*, 1942, **4**, 53; *Science and Culture*, 1942, **8**, 16. 6. Annet, *Biochem. J.*, 1920, **14**, 621; *Mem. Dep. Agric. India*, 1921, **6**, Nos. 1 & 2. 7. Dunnicliff, Private Communication.

PROTOGYNY IN UGANDA *SPONTANEUM*

The wild species of *Saccharum spontaneum* has been of particular importance and use at the Imperial Sugarcane Station X CBE. Most of the Co. canes found useful in cultivation have in them the blood of some form of *Saccharum spontaneum* and sometimes of two

forms of it. The Station now possesses one of the best collections of this species collected practically from all parts of the world. Recent additions to this collection are certain *spontaneums* from Uganda (East Africa). Two of these flowered last month and exhibited peculiarities which have so far not been recorded in any variety of *S. spontaneum* or in any species of *Saccharum*. While this is interesting in itself, the main point to which attention is now invited is their protogyny which enables their employment as ovule parents in sugarcane breeding.

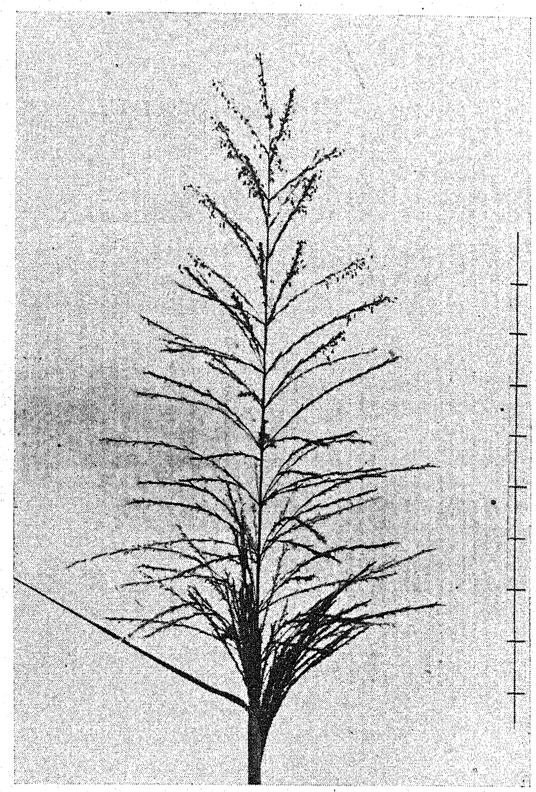


FIG. 1

The arrow of Uganda *Saccharum spontaneum*

The spikelets have opened in the upper portion. In the lower portion the stigmas are protruding from the tips of the unopened spikelets and can be made out with the help of a hand lens. The scale alongside shows inches.

In the other forms of *S. spontaneum* the spikelets begin to open only after the arrows have emerged about four inches from the leaf-sheath and the sequence of exsertion of essential organs is that the sigmas protrude as soon as the glumes are thrust apart by the swelling of the lodicules; and after an interval of about 15 minutes anthers also come out of the glumes. In the Uganda *spontaneum,* on the other hand, the stigmas begin to come out of the glumes while the arrow is still inside the leaf-sheath in the top two to three inches of the arrow. The spikelets do not open till four or five days after the protrusion of the stigmas. In Uganda *spontaneum* the flowers are thus protogynous which renders self-fertilization difficult.

FIG. 2

The spikelets of the Uganda and Coimbatore *spontaneums*

Note the stigmas protruding from the apex of the Uganda spikelet and from the sides of the Coimbatore spikelet. Note also the difference in the size of stigmas.

The diurnal opening of the *S. spontaneum* spikelets is between 7-00 and 7-15 a.m., but the Uganda *spontaneum* spikelets open only at about 9-00 a.m. Its anthers are yellow like the other *spontaneums* though somewhat deeper in colour and the tips are reddish-brown. In all the other *spontaneums* the pollen flows out easily and very little remains inside of the anther-sac. The Uganda spikelets close at 11-00 a.m., so that they remain open for two hours while in the other *spontaneums* spikelets close one hour after their opening. It will be seen in Fig. 2 that the stigmas of the Uganda *spontaneum* protrude from the apex of the spikelet while those of *S. spontaneum* Coimbatore protrude from the sides of the spikelet.

Protogeny is essentially a device to secure cross-pollination. As is well known, protandry is the more frequent form of dichogamy and occurs in most plants.[1] Even in grasses protandry is characteristic of the majority of the genera and though protogyny is rather rare, it is met with in a few genera like *Anthoxanthum, Pennisetum,* etc.[2]

One very good characteristic of the Uganda *spontaneums* is their erect habit. Advantage has, therefore, been taken of the protogynous nature of the Uganda *spontaneums* and one of them has now been crossed with different species of *Saccharum*. It is also proposed to cross them with certain of the *Sorghum* and

Bamboo seedlings to yield a few more tri-generic hybrids of desirable characteristics.

N. L. DUTT.
M. K. KRISHNASWAMY.
Imperial Sugarcane Station,
Coimbatore,
November 2, 1942.

1. *Strasburger's Text-Book of Botany*, 5th Eng. Ed., 1921, p. 559. 2. Bews, J. W., *The World's Grasses*, 1929, p. 22.

ON AKINETE FORMATION IN *ZYGNEMA TERRESTRIS* RANDH.

THE object of this communication is to describe a peculiar method of akinete-formation in *Zygnema terrestris* Randh. from material collected near Dhakuri in Kumaon Himalayas, and to record the presence of this alga in Kashmir.

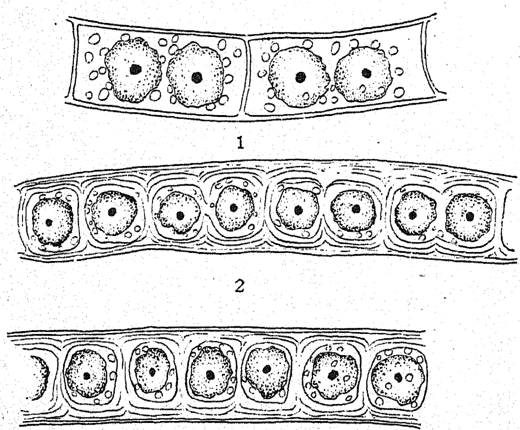
AKINETE-FORMATION

The following three modes of reproduction have been described by the present author[2,3] in this alga, so far.

1. Sclariform conjugation.
2. Lateral conjugation.
3. Aplanospore formation.

The material was collected by the author from near Dhakuri in Almora district at an altitude of about 9,000 feet above sea level in the middle of September 1939. In this material no conjugation lateral or scalariform was observed, and akinete-formation appears to be the exclusive mode of perennation.

Prior to akinete-formation cell-wall becomes thickened and lamellated. In mature akinetes cell-wall is about 6 μ thick, while in ordinary vegetative cells, it is only about 2 μ



Zygnema terrestris Randhawa

FIG. 1. Vegetative cells. Mark the thin cell-wall. FIG. 2. Early stages in akinete formation. FIG. 3. Mature akinetes. Mark the single chloroplast in each akinete.

thick (Fig. 1). The peculiarity of this form lies in the fact that akinetes are not formed by the direct conversion of vegetative cells into akinetes, as in *Zygnema giganteum* Randh. or oher forms, but the vegetative cells divide into two more or less equal halves by the ingrowth of septa from the side walls, which ultimately meet in the middle (Fig. 2). So each half contains one chloroplast only surrounded by food-reserves, like starch and oil (Fig. 3). The cell-contents stain more or less black with iodine, and deep blue with Nile Blue. The akinetes are 24-27 μ broad and 18-21 μ long, *i.e.*, half as long as an average vegetative cell. There is greater economy of material in this mode of akinete-formation, for double the number of akinetes is formed. Akinete-formation is a mode of perennation in this alga in the high altitudes.

As regards the cause of their formation, it is very likely that low temperatures prevailing in high altitudes are responsible. This is partly borne out by the fact that no akinetes were ever observed in the material of this alga collected from the plains. According to Fritsch[1] in species of *Mougeotia* and *Zygnema*, which inhabit mountain-lakes in Europe with relatively low temperatures, akinete-formation is common. This alga too was collected from the alpine zone in the Himalayas and intense cold may be the cause of akinete-formation.

It is remarkable that this alga in the plains and at an altitude between 5,000 to 6,000 feet shows scalariform conjugation, between 7,000-8,000 feet shows lateral conjugation exclusively, and higher up shows akinetes only.

DISTRIBUTION

Originally collected from certain fields in Fyzabad district, in the plains of Oudh, this alga was later on collected from Kausani and Binsar in Kumaon Himalayas, Almora district. A laterally conjugating form of this alga was found near Dhakuri, at an altitude of about 8,000 feet. The material showing akinete-formation described in this paper was collected higher up in the alpine zone above Dhakuri.

On 4th August 1941, the author collected this alga from the shores of Sheshnag, an alpine lake, with glaciers on two sides, at an altitude of about 12,100 feet. This lake which is the source of Sheshnag river, a tributary of Liddar, lies on the pilgrim route to Amar Nath Cave. There was a pure growth of this alga, visible from the bridle-path in the form of a yellowish-green belt contrasting with the turquoise blue water of the lake. It formed a mat-like covering over a huge area. It was found in a purely vegetative stage, and it is likely that akinetes or conjugating material may be found in September. It is of interest to find this alga so widely distributed in the Western Himalayas from Kumaon to Kashmir.

M. S. RANDHAWA.
Deputy Commissioner's House,
Rae Bareli (U.P.),
November 28, 1942.

1. Fritsch, F. E., *The Structure and Reproduction of the Algæ*, Cambridge Univ. Press, 1935, **1**, 336. 2. Randhawa, M. S., "Observations on some Zygnemales from Northern India, Part I." *Proc. Ind. Acad. Sci.*, 1938, **8**, 144 and 149. 3. Randhawa, M. S., "*Zygnema terrestris* Randh. from the Kumaon Himalayas," *Curr. Sci.*, 1940, **9**, No. 8, 373 and 374.

RICCIA GANGETICA AHMAD

I HAVE read with interest Mr. Ahmad's paper on "Three new species of Riccia from India" published in *Current Science* for November 1942. Mr. Ahmad has missed the supplement to "The Liverworts of the Western Himalayas and the Punjab Plains" Part I; otherwise he would not have treated *R. gangeticas* as a new species. Below is the description of *R. himalayensis* St., as given by Kashyap side by side with the description of *R. gangetica* Ahmad.

R. himalayensis St.	*Riccia gangetica* Ahmad
Diœcious or monœcious lobes upto 8-10 mm. long. Dorsal surface green with a median sulcus. Air spaces narrow, slit-like cross-section three times as broad as high.	Monœcious. Thalli up to 20 mm. in diameter. Dorsal surface bluish green with a median sulcus. Air spaces narrow, slit-like two or three times as broad as high.
Scales small, semilunar distant, purple or hyaline, *bent over the margin.*	Scales prominent, semilunar, colourless or pink, *never extending beyond the margins.*
Antheridia in one median row.	*Antheridia and archegonia uni- or bi-seriate along the median line.*
Spores 90-110 μ, in specimens from Negapatum upto 132 μ; dark brown to opaque.	Spores 112-134 μ, *ellipsoid,* black.
Surface reticulate, margin usually with long processes which are prolongations of the walls of the reticulations.	Surface reticulate, low walls separating the areoles, margin obscurely dentate.
In specimens from Spiti the reticulations faint (naturally the margin would be faintly dentate).	

Above comparison shows that *R. gangetica* differs from *R. himalayensis* in having (1) shorter scales, (2) uni- or bi-seriate antheridia and archegonia, (3) Ellipsoidal spores.

Reduction in scales as a result of the hygrophyllus mode of life is very common in liverworts and bi-seriate archegonia and antheridia cannot be considered as a specific difference.

Botany Department,
Panjab University,
Lahore,
December 15, 1942.

R. S. CHOPRA.

REVIEWS

Mathematics: Its Magic and Mastery. By Aaron Bakst. (Chapman and Hall, London), 1941. Pp. xiv + 790. Price 21*sh.*

This book of over 700 pages of clear printing, attractive head lines, and pleasing cartoons, is a very neat and successful dressing for those mathematcial dishes that are usually offered for the general education of the public up to the matriculation standard. All those elderly "juveniles" who continue to retain a taste for figures and an interest in reading are sure to find vast enjoyment in this book. It differs from the classical treatments of amusements in mathematics for the sake of mathematics, and is largely concerned with the aplication of the methods of elementary mathematics in the various fields of human endeavour, without bothering the reader with any abstract conceptions or abstruse procedures.

The book is divided into 37 chapters with an appendix of equations and Tables. Given below are some selected chapter headings and sub-headings: Systems of Numeration (Home work was never like this $1 + 1 = 10$), the Arithmetic of Measurement, Rapid Calculations, The Grammar of Algebra (The silk stocking bargain bubble, dream of an opium eater, the family-minded fly, the arithmetical plague of Australia, the how many times ladder, a sequence for the rabbits, a clever rat, the banker's mathematics), Streamlining Everyday Computation, How to have Fun with Lady Luck, Post Office Mathematics, Man's Servant —The Triangle, The Triangle—Man's Master, the mathematics of Seeing, the Shape of Things, Escape from Flat Land, Cork-Screw Geometry, The Firing Squad and Mathematics.

A Handbook of Shellac Analysis. By M. Rangaswami and H. K. Sen, Indian Lac Research Institute, Namkum, Ranchi, 1942. Pp. 106 + xvii. Price Rs. 3-4-0.

Shellac—the commercial form in which lac is mostly exported—has remained one of India's monopolies. The Indian Lac Cess Committee, sponsored by the Government of India, has played an active part in helping to maintain the supremacy of lac in trades and industries where its special qualities are valued, in spite of keen competition from synthetic substitutes. Like many other natural products, lac varies in composition depending upon the host which feeds the parasite, the race of insect which secretes it and the season in which the crop is raised; it also depends upon the conditions of storage, the mode of treatment it receives during the various industrial operations which intervene between stick lac and shellac. Further, the uncertain and inflated prices which have ruled the shellac

market in the past have constituted a great temptation for several manufacturers to adulterate shellac with cheaper resins.

The natural and inherent factors and the unnatural and avoidable circumstances described above, have frequently disturbed the shellac market in Europe and America and foreign consumers have insisted that shellac and other forms of lac should conform to certain specifications laid down by them. The demands of modern industry are becoming more and more exacting with respect to its natural raw materials. These are expected to satisfy a certain degree of uniformity in its chemical and physical properties as revealed by standardised methods of analysis.

Valuable publications on shellac analysis have been issued by the leading importers and exporters of this commodity in America, England and also in India. In addition there are contributions on this subject from individual research workers and these have been scattered among several scientific journals. As the authors have remarked in their preface, "the various trade interests are still not agreed upon what fundamental and special tests should constitute the analysis of lac and no one method exists for the examination of any particular property."

The Indian Lac Research Institute at Ranchi has for sometime been engaged in this problem of shellac analysis and the Institute has the enviable advantage of being able to obtain genuine samples of every type and every form of lac for research. The Handbook of Shellac Analysis under review, includes a substantial portion of the experimental work and wide experience accumulated during the past twenty years. The authors have rendered a great service to the Indian lac industry by bringing together all the available methods of shellac analysis into one volume and by appraising them critically in the light of their own valuable experience. It is earnestly hoped that the Handbook will receive the wide publicity it deserves and focus attention on the necessity of evolving a uniform and universally acceptable system of analysis for the various grades and forms of shellac.

The Effect of Range of Stress on the Fatigue Strength of Metals. By J. O. Smith. (*Bulletin of the University of Illinois*, 1942, 39, No. 26, February 17.) Price 55 cents.

The important problem of the Effect of Range of Stress on the Fatigue Strength of Metals has been thoroughly studied and investigated by Mr. J. O. Smith of the University of Illinois. As a result of these investigations a new definition has been evolved for the "Endurance Limit" of a metal under fatigue. This has been defined as the maximum alternating stress which may be superimposed on a given steady stress and repeated an indefinitely large number of times without causing a fatigue fracture. The effect of range of stress on the fatigue strength has been studied with respect to a number of metals, both ductile and brittle, for notched and notch-free specimens and for various ranges of stress in which the steady stress was tension and compression. The author, however, assumes that the results obtained from direct axial tension—compression stresses are also applicable to bending merely on account of the difficulties involved in determining the value of the Ranges of Stress in Bending. This fact has yet to be confirmed by experimentation for various ranges of Bending Stresses.

Two sets of diagrams have been evolved. One The Maximum Stress—alternating stress diagram and secondly, the Steady Stress—alternating stress diagram in which the alternating stress is the Endurance Limit for the corresponding steady stress of the range of stresses. These diagrams are the modifications of the Goodman diagram and are called as such. These are very useful in determining the working stresses of metals under various ranges of stresses, and also the area of cross-section of members under those stresses. All the test data have been illustrated by means of these diagrams.

A set of conclusions drawn from all these data and a Bibliography have been added at the end of the report, which are very useful for further work on the subject.

S. K. L. NARAYANA.

Eighth Progress Report of the Joint Investigation of Fissures in Railroad Rails. By H. F. Moore. (*Bulletin of the University of Illinois*, March 1942, 39, No. 28.) Price 15 cents.

This investigation has been carried out by the Engineering Experiment Station of the University of Illinois jointly with the Association of American Railroads and the Rail manufacturers' Technical Committee. The usual Batter and Hardness measurements have been conducted on Rails in Service and a big table of results has been recorded. In this connection Messrs. R. Jensen and N. J. Alleman point out how the end hardening of rails will make the Brinnel Hardness number of the material constant, even after several million tons of traffic. Mr. R. E. Cramer has further studied this subject and finds that rails develop a sort of weeping cracks which can eventually be built up by welding. These may be due to the excessive end hardening of rails above the Brinnel Hardness number 400. These may also be due to slotting of rail ends or notches on the ground end of the rails near the railtread. But these are not substantiated by experimental results.

Finally Mr. Cramer gives a list of proposed recommended practice for control cooling of rails with or without hydrogen ingots. He also gives a number of lists to determine the manner of growth of shatter cracks well illustrated by microscopic photographs. Messrs. Alleman and H. F. Moore deal with a comparison of drop and bend tests on rails, in which they define the "Force of a Blow" and the several methods of determining the same. All of them are illustrated by a number of test results and are very useful for further work on the subject.

S. K. L. NARAYAN.

LAND MANAGEMENT IN THE PUNJAB FOOTHILLS

Land Management in the Punjab Foothills. By R. Maclagan Gorrie, D.Sc. (The Punjab Government Press, Lahore). Pp. vi + 78 + xii. Price Re. 1-6-0.

THE reviewer has found this booklet exceptionally interesting and worthy of careful study even by those who may not be directly concerned with the main subject, *viz.*, the prevention or correction of erosion. The author's object is certainly fulfilled, *viz.*, "to place in the hands of all who may be concerned with the administration of land a concise statement of the true aims of land management in language which can be understood by those who have not had a scientific training in agriculture or kindred subjects".

On almost every page some questions of importance are raised either directly or incidentally. The impact of these questions on the reader will depend on his particular view-point. To the present reviewer the outstanding impression was the sad effect on the whole agricultural economy of India of the constant quest after cheapness. This indeed is apparent even in the get-up of the booklet where economy in printing has been sought at the cost of the practical destruction of the effectiveness of the excellent photographs taken evidently with great care by the author.

Apart from the naturally depressing effect on the artistic photographer the reader is deprived of the satisfaction arising from the contemplation of good work, and there is left in fact once more the suggestion of the essential "katchaness" of Indian work. The suggestion, it may be said, if largely true, is quite unnecessary, since good work can be done in this country if only requisite measures are adopted.

At any rate this trouble should not arise with Government publications intended to stimulate better work in their own sphere by those for whom these publications are issued. In relation to the subject of the booklet the trouble of cheapness finds its main expression in the uncontrolled grazing of unlimited herds of very inferior cattle. No doubt poverty and other excuses may be found, but surely what is needed is a strong handling of the whole question, sympathetic understanding being combined with resolute firmness. The aim of necessary education should be, apart from its ultimate ethical basis, which means an awakening of social consciousness at present entirely dormant, to show the ultimate benefit accruing to all and sundry by the adoption of rational methods of cattle breeding and feeding. A few carefully selected and stall-fed animals would bring directly more profit to the farmer and indirectly would prevent great ultimate loss in the ruin of fertile areas of land.

This same principle of spending more on less, as against spreading available expenditure so thinly that its ultimate effect is virtually nil, applies not only to the problem of land management but in many other directions where public money is concerned. Thus in a sphere with which the reviewer is familiar, *viz.*, water supply and sewage disposal, it is of little use to spread available money so thinly that real purification of the water before and after use is not attained. If the money was intensively spent so that complete purification of a portion was actually realized, this would really give better results than the same amount of money thinly spread, not only for technical reasons which need not be here discussed but also for what is perhaps of equal importance, *viz.*, that the portion properly handled would provide a standing model to be followed in later developments.

It is of interest to compare the recommendations in the booklet under review with those made many years ago in the famous report on the "Improvement of Indian Agriculture" by the reviewer's late and highly esteemed friend, Dr. J. A. Voelcker. Many of Dr. Voelcker's suggestions have since been carried out with great benefit to the country and in other directions it can be seen from Dr. Gorrie's pages that these recommendations have been developed still further. Thus, for example, in the necessary production of organic manure the old-new method of "composting" has resulted, if scientifically carried out, in a great increase of valuable fertilizer without in many cases an entire deprivation of cowdung cakes for fuel purposes. For this last much criticised practice good excuses may sometimes be found, *viz.*, in the absence of other fuel, especially it may be said under war conditions, and in the peculiarly slow-burning efficacy of cowdung.

The distinction made between the valuable qualities of sheep and goats is almost reminiscent of Scripture. Yet it appears that even goats have very special uses provided they are intelligently bred and controlled. No one who has had charge of a woodland or even a garden will deny for a moment the absolute wickedness of the ordinary goat, who will destroy a valuable tree very quickly by eating round the bark everywhere within reach. Unfortunately it is not only four-footed goats who are guilty of this practice, but surreptitious two-legged seekers after cheap fuel who chop the bark from the lower portions of magnificent old trees, entirely reckless of their possible ultimate destruction. This kind of thing which every dweller in the Indian countryside, or country property owner, has met sometimes, raises the question whether the excessive "respect for property", the evil of which is now becoming widely recognized by thoughtful people, may not at one time at any rate have had some useful basis in preventing indiscriminate stealing. No one would justify the harsh laws formerly existing in England against sheep-steeling and theft in general, but it is possible that it may not have been without effect in developing subconsciously a regard for the Eighth Commandment.

The whole outlook on economics especially in relation to social welfare demands far more attention than it is yet receiving by the general public. At the same time it is encouraging to know that the movement for a rational view-point and for a true concept of wealth

is now finding utterance in the British Parliament, and the Economic Reform Club and Institute of London beginning in a small way is now greatly increasing its scope and usefulness. All these large questions of land management dealt with in the booklet under review would be far more easily and promptly handled if the bogey of financial stringency was not always raised. The enormous expenditure on war material now going forward is opening the public's eye to the fact that money is only a token which under proper public management, as apart from profit-making banking companies, can be made to correspond with the labour and other services required for these measures of improvement. The instance given in the booklet of valuable results from co-operative labour shows how when there is a will and understanding great things are possible.

It may be hoped that Dr. Gorrie's booklet will be of value not only in India but in other parts of the world where erosion problems have to be faced. In the Federated Malay States, for example, it was pointed out to the reviewer many years ago that owing to the accumulation of flood-borne silt the beds of several of the rivers had risen to the arches of the bridges. Apart from suitable training of such rivers the value in many cases of the silt as manure should not be forgotten. This point is made by Dr. Voelcker but possibly because the conditions are not comparable in the areas referred to in the booklet, this aspect of the question is not emphasised by Dr. Gorrie.

A word may finally be said with regard to fodder reserve. It is rather curious that while at one time the value of spineless cactus was recognised and much advertisement was given to Luther Burbank's efforts in developing such a plant, work which has been done in India in comparatively recent years seems to have been forgotten. Reference may be made to a valuable article by Dr. Burns in *Indian Farming* for October 1940 in which he mentions several efforts made in former years to develop spineless cactus in India, amongst others an attempt by the present reviewer and his colleagues at the Indian Institute of Science. This was so far successful that an excellent growth of the plant was still spineless after nearly fifteen years.

Altogether it will be seen that the booklet is full of practical and at the same time thought-provoking proposals and it may be hoped that it will have a wide circulation not only amongst specialists, but, as the author hopes, among the educated public generally.

GILBERT J. FOWLER.

CENTENARIES

Potter, Nathaniel (1770–1843)

NATHANIEL POTTER, an American epidemiologist, was born at Easten in 1770. He graduated in medicine in 1796 from the University of Pennsylvania. He became the first professor of medicine in the Medical College of Maryland on its establishment in 1807 and kept that position till his death. He wrote profusely and was Editor of *Baltimore medical and philosophical lycaeum* (1811) and joint-editor of *Maryland medical and surgical journal* (1840-43). The fame of Potter rests largely on his service to the epidemiology of yellow-fever. He established its non-contagiousness by lending himself to experimentation. In 1797 he tied up around his head a piece of muslin dipped in the perspiration of a patient dying with yellow-fever and keeping it all the night. In 1798, he inoculated himself with the perspiration of a yellow-fever patient in the last stages of the disease. Potter died at Baltimore, January 2, 1843.

Fitch, John (1743–1798)

JOHN FITCH, an American inventor, was born at Windsor, Hartford county, January 21, 1743. After spending five years in an elementary school, he was put on his father's farm even when he was but ten. As he was a weak child, farm work made his life unhappy and so after five years, he changed over to the service of a shop-keeper. Finding this too unsuitable, he shifted from one calling to another, until at last he turned his attention to the invention of steam-boat in 1785. By 1787, his first steam-boat was launched on the Delaware river at Philadelphia in the presence of the members of the Congress. In 1788 he launched a bigger boat, 60 feet long, and carried as many as 30 passengers, covering 20 miles in about 3 hours. In 1790, he built a still larger boat and this was put to regular service and Fitch got a patent from the U.S.A. and from France. In 1791, he started work on his fourth boat, named *Perseverance*; but it was destroyed before completion by a violent storm. This disaster virtually ended his career. After sojourning for four years in France and other places in search of a more favourable opportunity to realise his ambition, Fitch died in disappointment at Bandstown, July 2, 1792.

S. R. RANGANATHAN.

University Library,
Madras,
January 4, 1943.

SCIENCE NOTES AND NEWS

House-freqenting Flies.—Fly reduction is a question of efficient sanitation; sanitation is no less a question of efficient fly control. This fact of intimate inter-relationship between the fly and sanitation in a town or village has been lucidly described in the Health Bulletin No. 31 (*"The House-frequenting Flies, Their Relation to Disease and Their Control"*, by I. M. Puri, M.SC., Ph.D.). As the author has, however, pointed out more than once, the amazing fact about this relationship is its failure to impress sufficiently the greater portion of the public, of its importance, to human welfare. The author is of the opinion that the public—literate as well as illiterate—need to be rigorously educated and constantly reminded about the basic facts of human diseases like typhoid, cholera, tuberculosis and infantile diarrhœa, etc., and the close relationship of the fly to these diseases.

By far the most prevalent house-frequenting fly is the common fly belonging to the genus Musca, having a number of different species in various parts of India. From the public health point of view, some eight species of Musca, four species of Lucilia, three of Calliphora, three of Chrysomia and two of Sarcophaga, are of considerable importance to India. The author of this Bulletin has done a service to the cause of sanitation in India by providing very simple keys for the identification of the different species of flies under each genus. The author has also dealt with the question of control of flies in a rather exhaustive manner, under different heads, namely, Prevention of Egg-Laying; Chemical Control of Fly-breeding; Biological Control of Fly-breeding; Control of Fly-breeding in Trenched Night-soil; and Measures against Adult Flies, involving screening, baiting, trapping and spray-killing.

Jute Substitute in Cuba.—It is understood that an experiment is being made in Cuba under Government backing to determine the commercial possibilities of *Malva blanca*, a plant which grows wild in Cuba and Venezuela. The fibre from this plant, it is claimed, is a good substitute for jute and can be made into bags for sugar, rice and coffee at a cost not greater than those made from jute. It is said that arrangements have been completed for the erection of a factory in Cuba for converting the *Malva* fibre into bags. This factory is expected to be ready by April next and will have an annual capacity of 6,000,000 bags.

Jute as Substitute for Wool.—In the Technological Research Laboratories of the Indian Central Jute Committee some knitted fabrics from jute ply-yarns were prepared and experiments are in progress to see if softening treatments can be found to make the material suitable to replace wool for such purposes as knitted jerseys, scarfs, etc.

Principles of Stellar Dynamics. By Prof. S. Chandrasekhar.—This book represents one of the most important recent additions to astronomical literature. The titles of the five chapters are: Kinematics; The Time of Relaxation of a Stellar System; Galactic Dynamics; The Dynamics of Differential Motion; General Dynamics of Stellar Systems; Spiral Structure; and The Dynamics of Star Clusters. Not only does the book provide a most excellent introduction to the whole field of Stellar Dynamics, but in it are contained highly illuminating discussions of some of the major current problems in astronomy, among them the probable interpretation of spiral structure. The book is one of the series of Astrophysical Monographs sponsored by the *Astrophysical Journal.*

Lady Tata Memorial Trust: Scientific Research Scholarships for 1943-44.—Applications are invited for six Scientific Research Scholarships of the value of Rs. 150 per month each for the year 1943-44.

The Scholarships are open to men and women, and will be tenable for a period of twelve months commencing from the 1st July 1943. Any or all the Scholarships may be extended for a further period of twelve months, within the discretion of the Trustees. All old scholars who desire renewal should re-apply.

Applicants, who must be of Indian nationality, must be Graduates in Medicine or Science of a recognised University. They must undertake to work whole-time and will be debarred from private practice. In the duration of the period of his scholarship or award the recipient of the benefit shall devote himself to the work before him to the entire satisfaction of the Trustees, who reserve the right to withold payment on the recommendation of the Advisory Committee.

The subject of scientific investigation which they may select must have a bearing directly or indirectly on the alleviation of human suffering from disease.

Application must be forwarded through the Director of a recognised Research Institute or Laboratory where the candidate proposes to work and must be accompanied by a letter from the Director stating that he has critically examined the details of the proposed Research, that he approves of the general plan and that he is willing, as far as possible, to guide and direct the investigation. and give laboratory facilities.

Candidates will be required to furnish the following additional information in their application, along with certificates of physical fitness and character:—

(*a*) Full Name, (*b*) Age, (*c*) Sex, (*d*) Permanent Address, (*e*) Details of Academic Career, (*f*) Particulars of their past and present Research qualifications, (*g*) Particulars of the proposed Research, (*h*) What other emoluments, scholarships and pay or any other financial support from friends or relations they are or will be in receipt of

during the period they are Scholars and the amount, if any.

Applicants must give (*a*) a short resume on the subject indicating present state of knowledge and (*b*) details of the proposed research indicating (*i*) the methods intended to be employed, (*ii*) previous experience in the use of these methods and (*iii*) the experiments to be carried out.

Applications, which must be typed, must give full particulars in the order indicated above and must be addressed to the Secretary, THE LADY TATA MEMORIAL TRUST, BOMBAY HOUSE, BRUCE STREET, FORT, BOMBAY, so as to reach him not later than 15th March 1943.

Indian Botanical Society: List of the Office-bearers for 1943.—*President*: Dr. K. D. Bagchee, Dehra Dun; *Vice-Presidents*: Principal P. Parija, Cuttack, and Prof. M. A. Sampathkumaran, Bangalore; *Treasurer*: Prof. M. O. P. Iyengar, Madras; *Secretary*: Prof. G. P. Majumdar, Calcutta.

Elected Members of the Executive Council: Mr. I. Banerji, Calcutta; Prof. Y. Bharadwaja, Benares; Prof. F. R. Bharucha, Bombay; Prof. S. R. Bose, Calcutta; Prof. H. Chaudhari, Panjab; Dr. A. C. Joshi, Benares; Prof. B. C. Kundu, Calcutta; Dr. T. S. Mahabale, Ahmedabad; Dr. P. Maheswari, Dacca; Rai Bahadur Prof. K. C. Mehta, Agra; Dr. B. P. Pal, New Delhi; Prof. M. Sayeed-ud-Din, Hyderabad (Deccan).

Editorial Board: Prof. S. P. Agharkar, Calcutta; Prof. H. Chaudhuri, Panjab; Prof. M. O. P. Iyengar, Madras (*Chief Editor*); Prof. G. P. Majumdar, Calcutta; Principal P. Parija, Cuttack; Prof. B. Sahni, Lucknow.

National Institute of Sciences of India.—The Eighth Annual General Meeting of the National Institute of Sciences of India was held on Friday, the 1st January 1943, in the University College of Science, Calcutta. The Report of Council for the year 1942 together with the audited statement of accounts was adopted and the Presidential Address by Dr. Baini Prashad, O.B.E., on "Conservation of Wild Life in India" was read.

The following Officers and Members of Council for the year 1943 were elected:—

President: Sir Jnanchandra Ghosh, Bangalore; *Vice-Presidents*: Prof. S. K. Mitra, Calcutta, Mr. D. N. Wadia, Colombo; *Treasurer*. Rai Bahadur K. N. Bagchi, Calcutta; *Foreign Secretary*: Prof. J. N. Mukherjee, Calcutta; *Secretaries*: Prof. S. P. Agharkar, Calcutta, Dr. C. S. Fox, Calcutta; *Editor of Publications*: Rai Bahadur S. L. Hora, Calcutta; *Members of Council*: Dr. K. Bagchee, Dehra Dun, Sir S. S. Bhatnagar, Delhi, Dr. F. H. Gravely, Kodaikanal, Prof. B. C. Guha, Calcutta, Dr. B. S. Guha, Benares, Dr. M. Ishaq, Aligarh, Dr. D. S. Kothari, Delhi, Prof. K. G. Naik, Baroda, Prof. V. V. Narlikar, Benares, Principal P. Parija, Cuttack, Dr. F. G. Percival, Jamshedpur, Dr. K. R. Ramanathan, Poona, Mr. B. Rama Rao, Bangalore, Prof. P. Ray, Calcutta, Prof. M. R. Siddiqi, Hyderabad (Dn.), Dr. N. K. Sur, Calcutta, Dr. K. Venkataraman, Bombay; *Ex-officio Members of Council*: Sir R. N. Chopra, Jammu-Tawi, Sir Lewis Fermor, Bristol, England, Dr. B. Prashad, Benares, Prof. M. N. Saha, Calcutta.

We acknowledge with thanks receipt of the following:—

"Journal of Agricultural Research," Vol. 65, Nos. 3 and 4.

"Agricultural Gazette of New South Wales," Vol. 53, No. 10.

"Allahabad Farmer," Vol. 16, No. 6.

"Annals of Biochemistry and Experimental Medicine," Vol. 2, No. 3.

"Journal of the Indian Botanical Society," Vol. 21, Nos. 5 and 6.

"Journal of Chemical Physics," Vol. 10, No. 9.

"Journal of Indian Chemical Society," Vol 19, Nos. 9 and 10.

"Experiment Station Record," Vol. 87, Nos. 2 and 3.

"Transactions of the Faraday Society," Vol. 38, No. 10.

"Indian Forester," Vol. 69, No. 1.

"Bulletin of the Indian Central Jute Committee," Vol. 5, No. 9.

"Review of Applied Mycology," Vol. 21, Pt. 9.

"Bulletin of the American Meteorological Society," Vol. 23, No. 5.

"Indian Medical Gazette," Vol. 77, No. 12.

"Nature," Vol. 150, Nos. 3798, 3806 and 3808.

"Journal of Nutrition," Vol. 24, No. 3.

"American Museum of Natural History," Vol. 50, No. 2.

"Indian Journal of Physics," Vol. 16, Pt. 5.

"Canadian Journal of Research," Vol. 20, No. 9.

"Science," Vol. 96, Nos. 2487-2490.

"Sky," Vol. 1, No. 11; Vol. 2, No. 1.

"Science and Culture," Vol. 8, No. 7.

"Indian Trade Journal," Vol. 147, Nos. 1904-1906; Vol. 148, No. 1907.

"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 12, Pt. 3.

BOOKS

Temperature Control. By A. J. Ausley. (Chapman and Hall, London), 1942. Pp. viii + 127. Price 13*sh* 6*d*.

Electrical Engineering Practice, Vol. II, Fifth Edition. By J. W. Meares and R. E. Neale. (Chapman and Hall, London), 1942. Pp. xii + 668. Price 35*sh*.

Modern Synthetic Rubbers. By Harry Barron. (Chapman and Hall, London), 1942. Pp. viii + 274. Price 25*sh*.

Biochemistry and Morphogenesis. By Joseph Needham. (Cambridge University Press, London), 1942. Pp. xiii + 785. Price 52*sh*. 6*d*.

SUPPLEMENT TO CURRENT SCIENCE

Vol. XII] JANUARY 1943 [No. 1

THE STRUCTURE AND PROPERTIES OF DIAMOND*

BY

SIR C. V. RAMAN

AS is well known, a study of the forms and properties of crystals enables them to be grouped in 32 symmetry classes, five of which appear in the cubic system. These symmetry classes are identified in theoretical crystallography with the 32 point-groups, these having as their sub-classes the various space-groups which specify the patterns of atomic arrangement within the crystal. In actual experience, crystals exhibiting a high degree of symmetry often contain far fewer atoms in each lattice cell than the full number of asymmetric particles required by theory to give such symmetry. This becomes possible when the atoms are located at special positions in the space-lattice, namely, at the intersection points of the axes and planes of symmetry of the crystal. If the atoms were mere geometrical points, their positions alone would determine the symmetry of the crystal. Actually, however, the atoms with their enveloping electronic clouds have a finite extension. It follows that the atoms themselves must possess certain symmetry characters to permit of their occupying such privileged positions in the space-lattice. The orientations of the atoms must accordingly be taken into consideration, and should be such as to satisfy the symmetry requirements of the crystal. Indeed, it may well happen that in an actual case, the orientations of the atoms are such that the crystal has a lower degree of symmetry than would be the case if the atomic positions alone determined its form and physical properties.

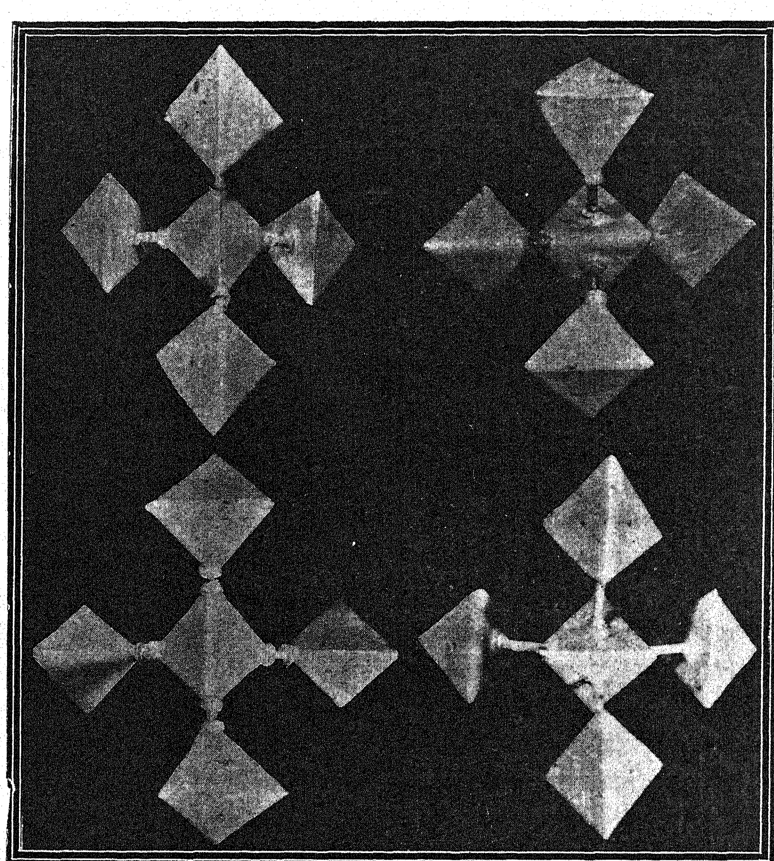
2. The Allotropic Modifications of Diamond

That a situation of the kind stated above may arise in the case of a diamond is *a priori* evident. As is well-known, the structure of this crystal embodies two interpenetrating face-centred cubic lattices of carbon atoms so located that each atom

* Presidential Address to the Eighth Annual Meeting of the Indian Academy of Sciences, at Bangalore, on the 26th December 1942.

in either lattice is symmetrically surrounded by four atoms in the other. The number of atoms per unit cubic cell in the structure is eight, four belonging to each lattice. To permit of such a simple structure for a cubic crystal, each carbon atom must itself possess a high degree of symmetry. The minimum symmetry which must be assumed is that of a tetrahedron. Assuming the atoms to possess only tetrahedral symmetry, the question arises as to how they are orientated in the unit cell. Several distinct possibilities may be envisaged. We may, for instance, assume each atom to be orientated in the same way as its four nearest neighbours along the body-diagonals of the cube, in the positive or negative sense. The structure would then not possess any centre of symmetry and would belong to the space-group T_d^2 in the hexakis-*tetrahedral* class of symmetry (E. V. Chellam, 1942). Alternatively, each atom may be oppositely orientated to its four nearest neighbours. Here again, there

I (*a*) I (*b*)



II (*a*) II (*b*)

FIG. 1

Possible orientations of the carbon atoms in diamond.
(Models and photographs by Dr. C. S. Venkateswaran)

are two distinct possibilities, since either the vertices or the bases of the opposing tetrahedra may face each other. In either of these two cases, it is apparent that the crystal would exhibit the full symmetry of the cubic system, its space-group being O_h^7 in the hexakis-*octahedral* class. It is thus seen that there are four distinct possibilities, in two of which the diamond has only tetrahedral symmetry, and in the other two, the full symmetry of the octahedron.

It is possible that we may also be concerned with combinations (in a quantum-mechanical sense) of the different arrangements represented in Fig. 1. If, for instance, types I (a) and I (b), or if similarly types II (a) and II (b) are superposed, the individual atoms as well as the crystal as a whole would possess octahedral symmetry. On the other hand, combinations of I and II (one each) would make the atoms in the two lattices possess different symmetries, while the crystal as a whole would possess only tetrahedral symmetry. Mr. G. N. Ramachandran (1942) has shown that all the different arrangements here contemplated would give zero intensity for the X-ray reflections by the (200) planes of the crystal, in agreement with observation. On the other hand, the so-called "forbidden" X-ray reflections, *e.g.*, those by the (222) and (622) planes, would appear with some models and not with others, the actual intensity varying with the combination chosen.

3. The Crystallographic Facts

Mineralogists are familiar with various special types of twinning as the result of which the true symmetry of a crystal is often disguised and forms of higher symmetry are closely imitated. In the hexakis-*tetrahedral* class, for example, an interpenetration twinning of "positive" and "negative" tetrahedra would enable the forms of highest symmetry of the cubic system to be exhibited. Since the positive and negative forms are physically similar and differ only in external orientation, such interpenetration would not easily be detectable by ordinary methods. The true symmetry of the crystal in such cases may, however, be inferred from its physical properties and also from the evidence of such facts as the unequal but symmetric development of four out of the eight octahedral faces, the appearance of octahedra with grooved edges, as also occasionally of single tetrahedra, of duplex tetrahedra, and of complete crystals exhibiting the 24 faces of the hexakis-*tetrahedron*. That the majority of diamonds have in reality only tetrahedral and not octahedral symmetry and that the higher kind of symmetry exhibited by the observed crystal forms arises from an interpenetration of positive and negative tetrahedra, is indeed evident from a study of the observed crystal forms of diamond. Examples illustrating each of the special crystal forms mentioned above will be found pictured by Sutton in his book (1928) based on 35 years' study at the South African mines. There is no doubt, however, that diamonds do occasionally appear which possesses the true symmetry of the hexakis-*octahedral* class.

The exact nature of the interpenetration twinning which appears in diamond cannot, of course, be predicted from purely theoretical considerations. It may, of course, be the case that the boundaries of separation within the crystal of the

interpenetrating species are wholly arbitrary, *viz.*, of irregular form and variable size. This may well happen when the two types are physically similar, *e.g.*, the positive and negative tetrahedra of the hexakis-*tetrahedral* class. On the other hand, it may reasonably be expected that interpenetration twinning of physically different modifications may also, as in the case of quartz, occur parallel to certain crystallographic planes. An inspection of the models illustrated in Fig. 1 suggests that when twinning layers appear in diamond, they should be parallel to the octahedral planes. It is noteworthy in this connection that a lamellar structure parallel to one or more of the cleavage planes of the crystal is a characteristic feature exhibited by certain diamonds. The observed facts thus find a natural explanation in the ideas set forth above.

4. The Infra-Red Absorption of Diamond

Since the difference between the tetrahedral and octahedral types of diamond arises only from the relative orientations of the atoms, neither variety of diamond would give any indication of electric polarity. A striking difference should, however, appear between the two kinds of diamond in respect of their infra-red absorption spectra. For the tetrahedral variety of diamond lacks a centre of symmetry, while in octahedral diamond this is present. Accordingly, a periodic motion of the two interpenetrating lattices with respect to each other should give rise to an oscillating electric moment in tetrahedral diamond and should therefore be infra-red active, while in octahedral diamond such oscillation would give zero moment and would be infra-red inactive. In both cases, however, such oscillation should give rise to a periodically varying optical polarisability and should therefore be active in light-scattering. As was first shown by Nagendra Nath (1934), the intense line with a spectral frequency shift of 1332 wave-numbers which appears in the light-scattering by diamond is due to such an oscillation of the interpenetrating lattices. This frequency corresponds to a wave-length of about 8 μ in the infra-red spectrum. The well-known fact that an intense infra-red absorption in the neighbourhood of this wave-length is exhibited by the majority of diamonds, while such absorption is absent in a less common variety of diamond thus receives a simple and natural explanation. Indeed, this variation in the infra-red behaviour furnishes the clearest proof that we are dealing with distinct allotropic modifications of diamond.

5. The Luminescence of Diamonds

One of the most remarkable properties of diamond is the visible luminescence which it exhibits under ultra-violet irradiation. Unlike that of pearls or rubies, the luminescence of diamond varies very greatly from specimen to specimen, both in intensity and colour. This is illustrated in Fig. 2 of which the left and the right halves are photographs of the same jewel taken respectively by ordinary reflected light and by the luminescence in ultra-violet light. The 88 diamonds with which the jewel is set (unlike the pearls, rubies and emeralds also seen in it) luminesce with enormously different intensities. Indeed, only the more strongly luminescent diamonds have come out in the picture owing to the moderate

exposures used, while the rest remain invisible. In the majority of diamonds, the colour of the emitted light is blue. Greenish-blue, green or greenish-yellow luminescence is, however, also observed in some diamonds. Strongly blue-fluorescent diamonds show a greenish-yellow phosphorescence which continues when the ultra-violet irradiation is cut off. Even when the luminescence is of the same colour,—blue for example—its intensity may vary by a large factor—up to say 10,000 in different diamonds.

The spectroscopic studies of P. G. N. Nayar (1941) and of Miss Anna Mani (1942) at Bangalore have greatly advanced our knowledge of the luminescence of diamonds. These investigators have found that in spite of the enormous differences mentioned above, the luminescence spectra of all diamonds (irrespective of their origin) are essentially similar and that this is also the case for the associated absorptions in the visible region of the spectrum. The principal features in all the spectra are the two narrow electronic bands at 4152 A.U. and 5032 A.U. respectively, appearing as bright lines in emission and as dark lines in absorption. Other radiations appear at longer wave-lengths in emission and at shorter wave-lengths in absorption than these electronic bands; these frequencies of

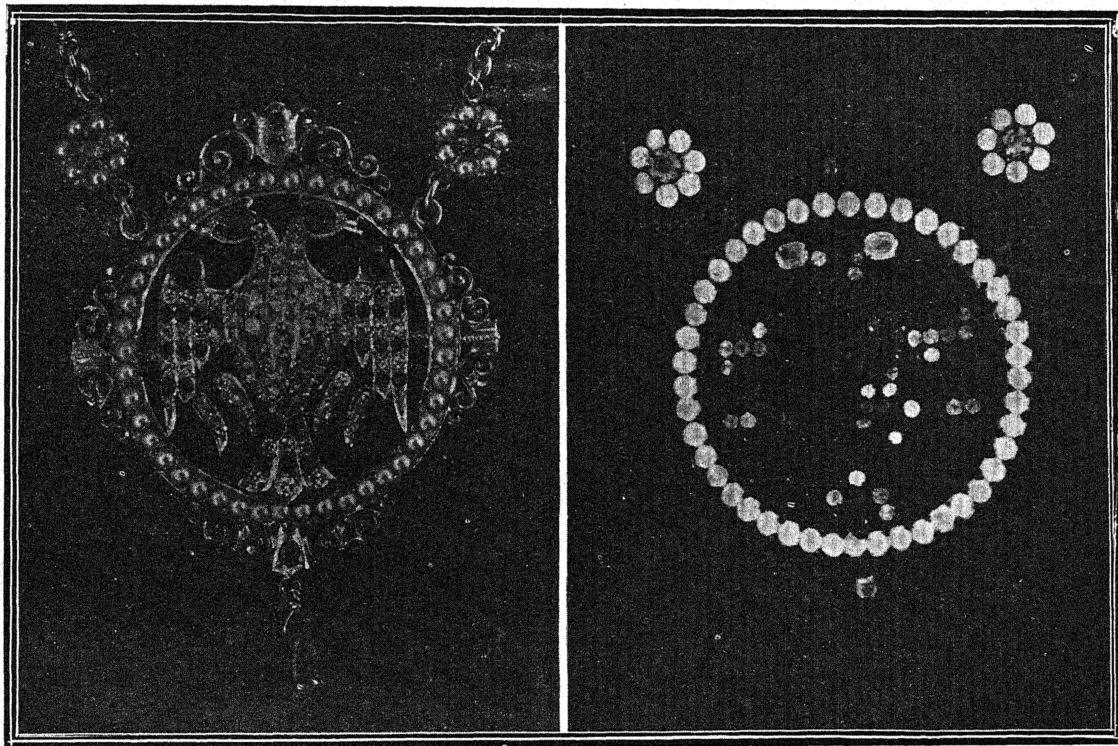


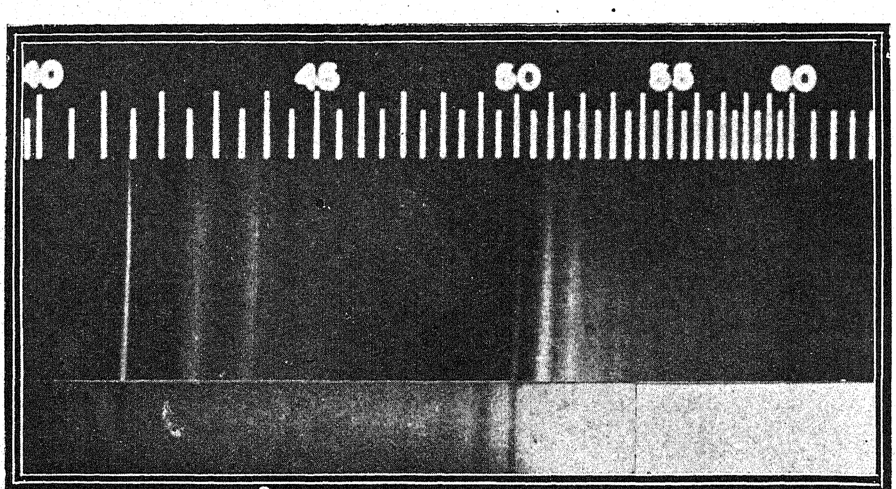
FIG. 2

Luminescence of diamonds, pearls and rubies.

(Photographs by Mr. T. M. K. Nedungadi)

emission and of absorption in every case exhibit perfect mirror-image symmetry about the electronic frequencies, thus showing that the frequency differences represent the vibration-frequencies of the crystal lattice. The differences in intensity and colour of the luminescence are brought about the variation of the absolute and relative intensities of the electronic emissions at 4152 A.U. and 5032 A.U. as well as of the associated radiations of longer wave-lengths. Corresponding differences in the absorption intensities are also exhibited.

The spectroscopic evidence clearly suggests that the luminescence is a characteristic property of diamond itself and not of any extraneous impurities which may happen to be present. This indication is further strengthened by the definite correlation which is found between luminescence and the other properties which differentiate the allotropic modifications of diamond. It is noticed, for instance, that diamonds which exhibit a blue luminescence, even if only feebly, possess the other properties, *e.g.*, the absorption in the near ultra-violet, which characterise the lower type of symmetry. On the other hand, if diamond is completely non-fluorescent, it is usually found to be of the higher type of symmetry. Another interesting fact is that the fractured edges of cleavage plates of diamond luminesce far more strongly than either the polished faces or the interior of the crystal. This is an indication that the luminescence is excited by a purely physical cause, namely, a disturbance of the regularity of the crystal structure. The variations in the intensity of the luminescence are then readily explicable as arising from the variation in the number and extent of such irregularities within the diamond. It is evident that an intimate interpenetra-



Luminescence

Absorption

FIG. 3

Luminescence and absorption spectra of green-fluorescent diamond at liquid air temperature.
(Photographs by Mr. P. G. N. Nayar)

tion of positive and negative tetrahedra in the diamond of lower symmetry, if it occurs, would constitute a disturbance in the regularity of crystal structure. Such interpenetration should therefore operate as an exciter of luminescence in diamond of this type, its intensity being determined by the area and distribution of the surfaces of separation. It is then unnecessary to postulate the presence of extraneous impurities in the diamond, and indeed if such impurities were the cause of luminescence, it would be difficult to understand why diamonds having the higher type of symmetry do not exhibit luminescence to anything like the same extent. On our present view, the latter fact finds a natural explanation in the circumstance that such interpenetration does not exist in the octahedral variety of diamond. The chemical or impurity theory is also discredited by the observation that strongly blue-luminescent diamonds are often of the highest quality in respect of transparency and freedom from colour.

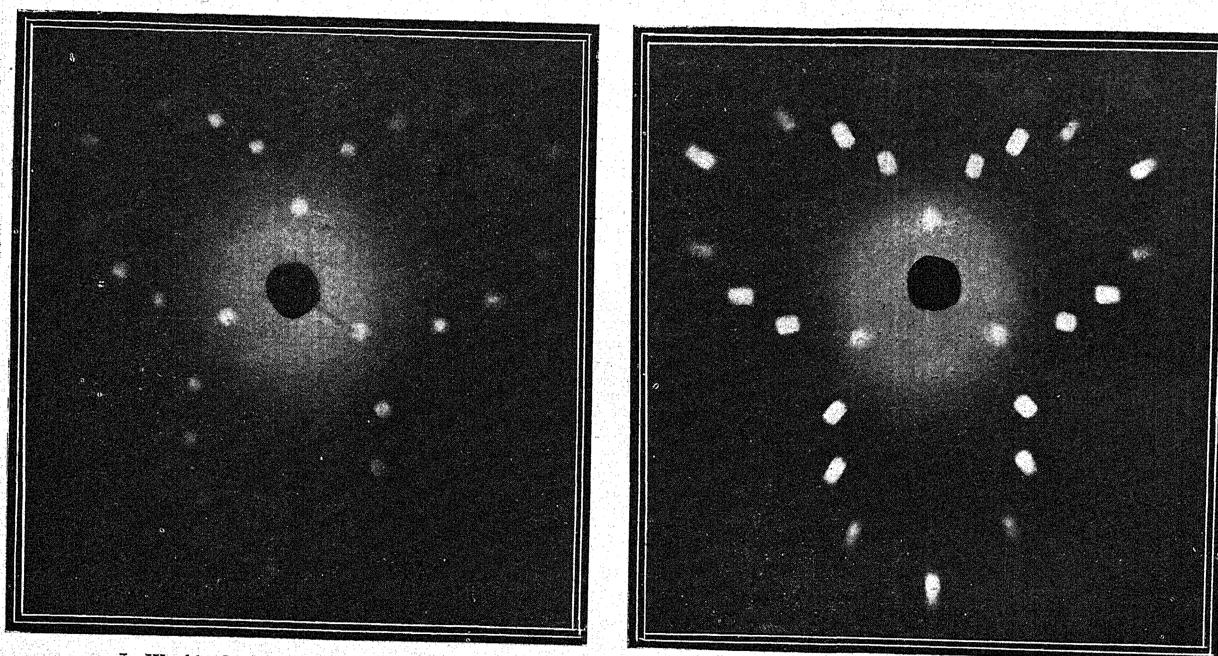
6. X-Ray Phenomena

The explanation of the luminescence of diamond put forward above has found striking support in an investigation by P. S. Hariharan (1942) of the X-ray reflections by diamond, both by the Laue and the Bragg methods, in the latter case with oscillating crystals. He found that the X-ray reflections increased conspicuously in intensity *pari passu* with the strength of the blue luminescence of the diamond under ultra-violet irradiation. His results leave little doubt that the exciting cause of luminescence is to be found in the irregularities of crystal structure. He also found that the diamonds which belong to the lower symmetry class and exhibit the blue luminescence with the least observable intensity are also the diamonds which give the least observable intensities of X-ray reflection and are therefore the nearest approach to the ideal diamond. *Per contra*, the diamonds which are non-fluorescent and belong to the higher symmetry class give extremely large intensities of X-ray reflection. The (111) Laue spots in the X-ray patterns of these latter crystals show a fine ripple-like structure of straight lines parallel to the atomic reflecting layers; from this, it may be inferred that the atomic layers in these diamonds are not strictly plane but have a periodic waviness or rugosity. The enormously increased strength of the Bragg reflections given by an oscillating crystal of this class thereby becomes intelligible. It is scarcely to be doubted that these rugosities made evident by the X-ray reflections are closely associated with the lamellar structure of these diamonds and with the streaky restorations exhibited by them in the polariscope which run parallel to one or more of the octahedral cleavage planes of the crystal.

The difference between the tetrahedral and octahedral types of diamond also manifests itself in respect of the phenomenon of quantum or modified X-ray reflection. All diamonds of the tetrahedral class, whether weakly or strongly luminescent, exhibit the triple quantum reflections by the (111) planes in a conspicuous manner. These reflections have been explained by the present writer as due to the excitation of the lattice vibrations of wave-number 1332 by the impact of the X-ray photons. Certain writers, notably Born and Lonsdale, have, on the other hand, supported the suggestion

that they may arise from a "peculiar state of strain having cubic symmetry present in such diamonds". It is obvious that a state of strain having cubic symmetry cannot possibly maintain itself in a finite crystal free from external stress, and that even if such strain existed, it would not give any observable effect other than a minute alteration of the crystal spacings. It is also and irregular restoration of light between crossed nicols as the result of visible faults or inclusions. These facts are sufficient to show that the *ad hoc* suppositions made by Born and Lonsdale are wholly without any physical foundation.

As already mentioned, the classical X-ray reflections of the octahedral variety of diamond are extremely intense. Remarkably



I. Weakly fluorescent tetrahedral diamond

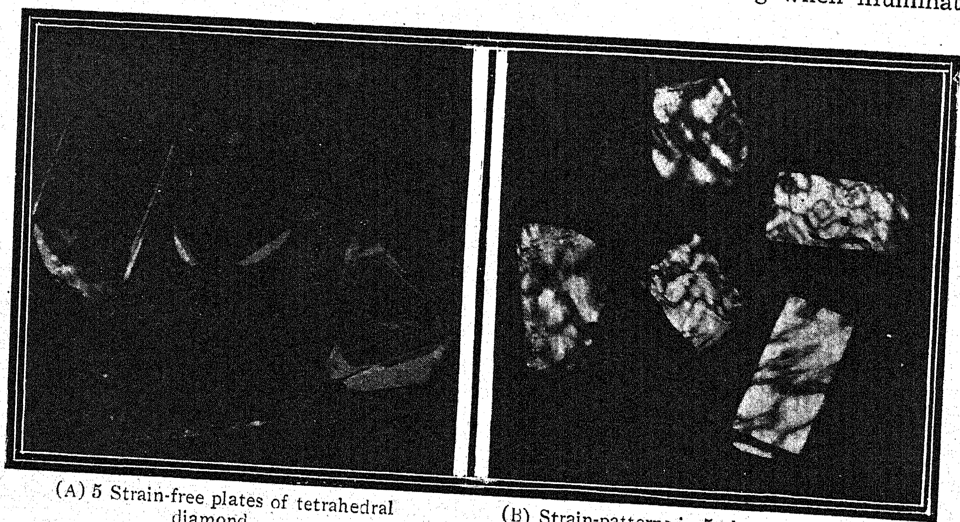
II. Strongly fluorescent tetrahedral diamond

FIG. 4

Laue patterns of weakly and strongly blue-fluorescent diamonds.
(Photographs by Dr. R. S. Krishnan)

important to remark that it is precisely the kind of diamond which exhibits the quantum X-ray reflections that can be obtained as cleavage plates completely from any strain detectable between crossed nicols. It is also found that such strain-free plates exhibit the quantum reflections to exactly the same extent as other plates of the same variety of diamond which show a strong enough, however, the diamonds of this class fail to exhibit the triple quantum reflections. This is regarded by Born and Lonsdale as a refutation of the ideas put forward by the present writer for explaining the phenomena observed with the other type of diamond. A closer consideration of the facts shows, however, that this difference in X-ray behaviour actually forms

strong evidence for the correctness of the views put forward by the present writer. It will be recalled that the two types of diamond differ in their infra-red behaviour in respect of the lattice vibration of wave-number 1332, this being inactive in octahedral diamond and active in the tetrahedral variety. This difference is a direct consequence of the difference in crystal symmetry. Similar considerations of crystal symmetry may be expected also to apply to the quantum-mechanical excitation of the same lattice vibration by the X-ray photons. The appearance of the quantum X-ray reflections with one kind of diamond and their non-appearance in the other kind then follows as an immediate consequence. In other words, this difference in X-ray behaviour of the two kinds of diamond is actually a proof that the movement of the crystal lattice which gives rise to the modified X-ray reflection is the same high-frequency vibration in respect of which the two types of diamond show such a remarkable difference of behaviour in infra-red absorption.



(A) 5 Strain-free plates of tetrahedral diamond

(B) Strain-patterns in 5 plates of octahedral diamond

FIG. 5

Plates of diamond between crossed nicols.
(Photographs by Mrs. K. Sunanda Bai)

7. PHOTO-CONDUCTIVITY

Diamond, as is well known, exhibits the very interesting property of becoming electrically conducting when illuminated by visible or ultra-violet light. Gudden and Pohl who studied this effect found that the diamonds which freely transmit ultra-violet radiations of shorter wave-length than 3000 A.U. exhibit the effect in a more striking manner than the diamonds which are practically opaque beyond that wave-length. They attributed this difference to the impurities which they assumed were present in the less transparent variety of diamond. This assumption, of course, has

no foundation, and we have to seek for a different explanation of the very remarkable experimental facts. Robertson and Fox (1934) showed that the greater transparency in the ultra-violet goes hand in hand with the absence of infra-red absorption at the wave-length 8 μ. It follows that the difference in ultra-violet transparency also arises from the difference in crystal structure, the tetrahedral diamonds being the less transparent and the octahedral diamonds the more. This difference in transparency cannot however, by itself, account fully for the striking differences in photo-conductivity, and it is evident that we have to seek for a further explanation on the same basis as for the difference in the luminescence properties. This question has been examined by Mr. D. D. Pant (1942) who has made observations with numerous specimens from the collection of diamonds in the possession of the present writer. From Mr. Pant's studies, it appears quite definitely that there is an inverse correlation between the primary effect in photo-conductivity and the luminescence of the diamond. Taking, for instance, the diamonds of the tetrahedral class, it is found that the more strongly luminescent they are, the smaller the photo-conductivity they exhibit. Indeed, the most feebly luminescent diamonds of this class exhibit the effect to an extent which is not vastly smaller than the non-fluorescent diamonds of the octahedral variety.

8. Some Concluding Remarks

Many of the physical properties of the allotropic modifications of diamond differ very little. Other properties, however, as we have seen, exhibit striking differences which enable us to distinguish between them. The luminescence exhibited under ultra-violet irradiation is by far the most easily observed and striking of these, and as already remarked, it exhibits most remarkable variations in colour and intensity. Numerous specimens in the possession of the writer even show variations of colour and intensity in different areas of one and the same specimen. These variations often take the form of bands and patterns of colour parallel to the octahedral cleavages of the crystal. The observations suggest that the tetrahedral and octahedral species of diamond may intermingle in the same specimen and that such intermingling is responsible both for the development of strain patterns and of luminescence patterns in the specimen. This is confirmed by the existence of corresponding local variations of the ultra-violet transparency of the diamond. The fuller consideration of these matters must be reserved for some future occasion.

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STATE'S RÔLE IN THE RECONSTRUCTION OF INDIA'S MINERAL POLICY

THE Geological Societies in India have been organising of late, symposia for formulating a national mineral policy for India. The trend of discussions which have taken place so far discloses a strong feeling for nationalisation and conservation of India's mineral resources for her own needs. If 'nationalisation' were to mean that the Central Government should hold the mineral rights throughout India and own all the mines, several complications are bound to arise. But if it suggests that the rights for minerals as distributed within the territorial jurisdictions of the several Indian States and British Provinces should vest in their respective Governments, the question assumes a simpler aspect. In fact, in most of the Indian States, and even in many of the British Provinces—except perhaps where permanent land settlement prevails, as in Bengal, Bihar and Orissa—the mineral rights vest already in their Governments. Whatever else may be the reason, it is not the lack of State ownership of mineral rights which has been the root cause for the unsatisfactory and tardy growth of India's mining and mineral industries.

So far, most of the Indian States and Provinces have left the prospecting and mining of their minerals to private enterprise. Foreign concerns with adequate mining experience and ability to command the required capital, took advantage of this and got possession of some of the valuable deposits of metalliferous minerals, like the ores of gold, manganese, chrome and copper. Many of these concerns generally conduct their mining with considerable skill and forethought, adopting the latest and the most advanced methods. The country, no doubt, has been largely benefited by their enterprises; but it is questionable whether the return it has got is quite proportionate to the total drain of its mineral wealth. Indian capitalists have fought shy in the past of risking their funds in mining, and the few who have ventured on these lines have generally concentrated their attention on raising only the minerals which can be readily exported without any further treatment or elaborate processing.

Many of the smaller concerns—due to their inadequate provision of funds, want of technical experience, absence of forethought

in planning, need of co-operative efforts, and also from the lack of vigilant State control to prevent and prohibit slipshod works—have been following the most wasteful and unprofitable methods of mining. The unscientific and uneconomical ways in which the coal deposits of the country are being mined and used have been pointed out so often that it is hardly necessary to mention them here. The reprehensible practice of scooping out only the best and the most easily accessible portions of the deposits leaving the rest untouched, would lead to the rapid depletion of most of our economic mineral resources as it has already happened in the case of manganese ores and mica. It should be remembered that mineral deposits, unlike forest or agricultural products, are the irreplenishable assets of the country. They cannot be accelerated in growth, or rejuvenated, by any scientific skill. No human efforts can either create a deposit if it does not exist or replenish that which may become depleted by extraction. Consequently, to get the utmost out of any deposit, scientific development and intelligent mining are absolutely essential and should be insisted on by the State. Large scale, serious efforts have yet to be made to investigate the possibilities of beneficiating the low grade ores of useful minerals, like chrome and manganese, and to use them widely in suitable local industries. An adequate local demand remains to be created for minerals like China clay, quartz, felspar and limestone which are widely distributed in the country and which can serve as raw materials for several useful industries. These common minerals have hardly attracted any attention and are lying almost as if they are unutilisable waste.

The growth of India's mining industries has proceeded so far without any organised plans or policies initiated by the State tending to meet the needs of the country at large. It is time for the State to change its passive policy. It cannot serve the country's interests effectively if it merely functions as the custodian of its mineral wealth or only an organisation for the collection of royalty. It should actively participate in the development of its mineral resources, formulate workable plans, initiate and aid the establishment of suitable mineral industries and guide their growth, and also manage a few—by its own organisations—to create confidence in the public and raise their interests in mining matters.

It may not be practicable for any Government to manage all the large-scale mining and mineral industries which can be suitably set up in the country. It is not desirable either that it should do so and prevent private enterprise. A concerted and co-operative effort between the State and its public for developing the country's mineral resources may work all the better. Indian capitalists are now coming forward to invest some funds in large-scale mining and mineral industries if they can get reliable technical advice and guidance. As far as possible it should be the duty of the State to furnish such technical advice when sought for, charging—if necessary—a reasonable fee.

The geological services available in India are very inadequate for such purposes considering the vastness of the country with its mineral deposits widely scattered. The Indian Geological Survey is stationed at Calcutta and its insufficient staff cannot serve the present needs of the whole country. Some of the enterprising Indian States have organised their own geological survey departments; but even these are poorly staffed and ill-equipped for modern methods of intensive investigations relating to mineral prospecting, mining, or ore treatment. Geology, as a private profession, has been hardly remunerative in India, as it has been in the advanced countries in the West; and, consequently, we find very few qualified and competent men practising as consulting geologists and mining engineers. As the first essential for a nation-wide policy to galvanise the rapid growth of India's mining and mineral industries, the State should create at once an adequate, efficient geological service for the country.

A Mineral Survey Department—with an adequate staff of competent geologists—should be organised immediately in each of the provinces, and such of the bigger Indian States as do not have that department, to conduct an intensive mineral survey. These departments should collect, as early as possible, accurate information on the extent and quality of all the economic minerals distributed in their respective territories. They should handle all problems connected with mineral extraction and utilisation, and exercise technical control over the mining and prospecting works of mineral concessionaires, to see that they

open out the deposits on approved systematic lines. They should do all the investigatory work in respect of the important deposits of their useful minerals; and may, with advantage, mine a few on the best approved modern methods to serve as models for the others,—like what Mysore has done in the case of some of her chromite, kaolin, and graphite deposits. Want of space precludes me from going into further details on the functions of these departments; in general they have to act as advisory institutions to their respective Governments as well as to the public on all matters connected with geological and mineral investigations.

These States and Provinces should have each, in addition, a "Mineral Utilisation Board", composed of the heads of the Mineral, Industrial Chemistry, Industrial Engineering and Industries Departments, to investigate ways and means for the local utilisation of minerals and to advise their respective governments as to the industries which they can advantageously set up.

It is very rarely that a single State or Province will have all the advantages it needs for establishing successfully any large-scale mineral industry. The best interests of India require a certain measure of co-operation and concerted planning among her various territorial units, and a free interchange of mineral products between the Provinces and States. To effect this, the Central Government should constitute a "National Mineral Utilisation Board" (apart from the present Utilisation Branch of the Indian Geological Survey) consisting, among others, of the heads of various provincial and State mineral survey departments, as its *ex-officio* members, to deal effectively with all mineral problems affecting the whole of India. This Board should co-ordinate the efforts of the several provincial and State mineral organisations, and discuss and decide the group of mineral industries which each of them can advantageously set up without any hitch or unhealthy competition amongst them. It should have, working under its general direction, several standing advisory committees like the following:—(1) Ceramic and refractory minerals committee, (2) Abrasive minerals committee, (3) Mineral Fuels committee and (4) Metalliferous minerals committee. Each of these should consist of a small body of experts who could deal authoritatively with problems connected with their sections and advise the National Mineral Board.

The Government of India should set up as early as possible a well-equipped "Central Mineral Research Institute" (on the model of the United States Bureau of Mines) to which any problems arising in the country on the various aspects of ore dressing, ore concentration, metallurgical treatments, etc.,—which the provincial and State organisations for want of adequate facilities cannot investigate—can be handed over for solution and advice. Apart from these few suggested ways there are several others in which the Central and Provincial Governments can aid the active growth of mining and mineral industries in India, which cannot be dealt with here.

The question of India's future policy in respect of conserving all her mineral resources is a delicate problem which needs handling with care and forethought. Nature's gift of her mineral wealth has not been based on the specific needs of any particular nation. No single country in the world can be regarded as absolutely self-sufficient in respect of all her mineral requirements for war and peace-time purposes. The present-day civilisation needs for its existence several minerals, and new ones are being continually added on to the list of those which may be considered as essential for the further progress of civilisation. Sir Thomas Holland, in his opening address at the Conference on "Mineral Resources and the Atlantic Charter", pointed out the other day (July 1942), that no civilised country can now exist without an adequate and sufficiently varied supply of mineral products and that tariff barriers, while capable of hampering international trade in mineral products, cannot prevent these trades altogether without creating conditions ultimately leading to war. He urges in consequence the formulation of measures to facilitate the international flow of mineral products.

The absolute need and the advantage of having a free interchange of mineral products cannot be gainsaid; but no good will result if the dominant nations were to decide these policies and jointly control the minerals of the former colonies and dependent States, prejudicial to the interests of those or of other weaker countries. Each country should have full scope to decide what its reasonable mineral requirements would be for its own development.

Among her mineral possessions, India can list, in all about a hundred or so of different types, which may serve for various industrial purposes. It would not pay to export, in their raw condition, many of these which may be classed as common minerals. They may be used advantageously in some one or the other of the several local mineral industries to which each would be found best suited. Among the minerals of international importance which would be required in the world's essential industries, India may possess a dozen including her high grade iron ores, bauxite, manganese ores, chromite, mica, monazite, ilmenite and a few others. Excepting iron ores and bauxite, India has been exporting the others, till now, in unrestricted quantities; and it is highly doubtful whether we have these minerals in such super-abundance—far in excess of our requirements—as to continue to share them for long, as common raw materials, with other countries.

India, in its present stage of industrial development, may not be conceded to be standing in need of a large share of the minerals of international importance; but the country's growing requirements necessitate the setting up—not at some distant future but immediately—of several essential industries which would require them as their raw material. In any consideration for an international mineral policy India cannot stand in isolation, and we do not mean either that she should do so and play the dog in the manger role in respect of her mineral resources. The Government of India, the Provinces, and the States, should endeavour to take an accurate stock of their mineral resources—as suggested above—and decide upon the various mineral industries which each could advantageously set up, so that when the time comes—which may not be far distant—for any considerations of international sharing of resources of essential minerals, India may have her plans ready and show the world her own need for most of the minerals which she possesses and for a few more which she has not got.

B. RAMA RAO.

THE CURRENT SCIENCE ASSOCIATION

FRIENDS of *Current Science* will learn with great satisfaction that the Journal will henceforward be conducted and issued under the auspices of the "CURRENT SCIENCE ASSOCIATION", a body which has been registered under the Societies' Registration Act 21 of 1860.

During the last ten years of its eventful career, the Journal has steadily earned for itself a prominent place in the field of international science and this happy circumstance is due to the whole-hearted and active support it has received from the several Governments, Universities, Research Institutes and the scientific workers in this country. During this period of its infancy, the Journal has had its share of teething troubles which fortunately have now been successfully overcome. The Journal now enters its second phase of development. With a view to ensure an ordered and steady progress, the Journal has been invested with a Constitution consistent with its All-India character.

At the end of 1941, the Editorial Board invited an *ad hoc* Committee to constitute itself and draft a constitution for the management of the Journal. After framing the Constitution, the *ad hoc* Committee advised the Editorial Board, at a meeting held on January 13, 1942, that immediate steps should be taken to register the "CURRENT SCIENCE ASSOCIATION". This suggestion was brought up for consideration before the Board of Editors at a meeting held on February 5, 1942, when they resolved to adopt the following:—

1. To register the "CURRENT SCIENCE ASSOCIATION" with a membership not exceeding one hunndred.
2. To appoint a Working Committee to administer, direct and manage the affairs of the Journal.
3. To transfer all the assets and liabilities of the Journal to the Working Committee of the Association.

The Working Committee has been constituted under the Presidentship of Sir Jnanchandra Ghosh; the Committee has appointed an Editorial Committee consisting of an Editor, a Secretary and a Treasurer to whom responsibility of the routine running of the Journal has been entrusted.

COSMIC RAY RESEARCH UNIT

INDIAN INSTITUTE OF SCIENCE

THERE is no doubt that the ultimate aim of all scientific activity is the discovery of the laws governing the behaviour of both the inanimate and animate world in order that the forces and properties of nature may be used for the benefit of humanity. The research work which has to be done before the forces of nature in any field can be used for human ends can be divided roughly into three stages. The first stage is one of pure research where the laws governing the phenomena in that field are still being investigated. The second stage is one where sufficient knowledge of the laws has been acquired to enable one to think of ways and means of applying them for human ends. The third stage is one in which our knowledge of nature in the particular field concerned has already been put to practical application, and research consists mainly in perfecting the existing appliances and methods by technical improvements. It is clear that of the three stages the first is the one which is most pregnant with possibilities for the future, and, indeed, without it the two subsequent stages could not exist. This type of research is usually described as 'pure' research for the simple reason that its applications are still too remote to be foreseen even by those actually engaged in the research. The third stage is called 'applied' or technical research, and industrialists are most easily induced to finance this stage since no particular vision is required to see the immediate benefits which result to mankind in general and their own pockets in particular from this type of activity. But it is obvious that technical or applied research can never open up entirely new fields for the service of humanity.

The history of wireless provides an excellent example of the process of development outlined above. The electromagnetic nature of light had been put into evidence by the researches of Faraday, and the laws of electricity and magnetism were put into their present mathematical form and expressed as a set of equations for the first time by Maxwell at about the middle of the last century. Maxwell realised that his equations required that electromagnetic disturbances should also be propagated through space with the velocity of light, and deduced that electromagnetic waves must exist in nature. It was left to Hertz to actually establish in 1887 that such waves are in fact sent out when a condenser is discharged. The second stage set in when following this result scientists tried to produce such electromagnetic waves artificially and to devise suitable apparatus for their detection. Then a student, Lord Rutherford was one of the first to make a detector to detect such waves which had passed through several brick walls over a distance of a hundred yards. This was in 1895, before Marconi had taken up the subject. The practical importance of these waves was immediately recognised, and several inventors including Marconi, began the attempts to improve the apparatus so as to make the transmission of signals more reliable and to extend it to increasingly greater distances. The third stage began when wireless telegraphy had become a fact and it was only a matter of improving the instruments and technical devices to bring radio to its present stage of perfection. This history brings out very clearly that wireless as we know it could not have existed without the pure researches of Faraday and Maxwell, and that at the time when Faraday and Maxwell did their work they could not even have foreseen the possibility of wireless communication and television.

In the case of Nuclear Physics we have the example of a field in which the first stage of pure research has been almost completed, and we are entering the second stage of attempts at application, with important successes in certain directions. Nuclear physics has already found a remarkable application as an instrument for the investigation of biological and physiological phenomena and allows us to tackle the problems of intermediary metabolism in a direct way which would be extremely difficult otherwise. The possibilities of its use in the treatment of hitherto incurable diseases also cannot be overestimated. On the theoretical side, our present knowledge

of nuclear physics has already enabled us to understand the process of stellar evolution for the first time. Finally, nuclear physics has opened up the possibility of extracting from a gram of matter a million times more energy than we extract at present by the process of chemical combustion, and there is no doubt that the practical application of nuclear physics to power production will put the most immense sources of power in human hands in the future. The problem is only one of doing on a practical scale what can already be done in the laboratory. Under the stimulus of war, money is being lavishly spent in America and Europe to find methods of using nuclear energy in a practical way and we may look forward to a successful application of nuclear physics to power production within the next few years. In nuclear physics, therefore, we have the example of a field in which the first stage has been largely traversed and we are entering the second.

In the case of cosmic rays we are still very much in the first stage. The great importance of cosmic rays is that on a single particle of cosmic radiation there is sometimes concentrated more than a million times the energy concentrated on any particle produced in nuclear phenomena, which in its turn is several hundred thousand times more than the energies involved per atom in the ordinary chemical and physical processes on which our life depends. Cosmic rays, therefore, provide us with the only means of studying matter in realms far beyond those studied by nuclear physics. The study of cosmic rays has already revealed certain absolutely fundamental processes of nature which have led to a revolution in our ideas of the physical world. The creation and the annihilation of matter has been established and effected in the laboratory and the existence of a new fundamental particle in nature, the meson, responsible for the stability of nuclei, and in consequence of matter in general, has been revealed. The laws governing one entire side of the cosmic ray phenomena are now completely known and expressed in mathematical form in the cascade theory first put forward by Bhabha and Heitler. But the behaviour of the more penetrating component of cosmic rays is still only partially investigated and there is every reason to believe that a complete understanding of the behaviour of the penetrating component will lead to a vital extension of our knowledge of the physical world.

The Sir Dorabjee Tata Trust, whose management consists of the foremost industrial interests in this country and whose far-sighted and generous munificence has been supporting many a scheme of fundamental research in this country, has now financed the setting up of a Cosmic Ray Research Unit at the Indian Institute of Science, under the direction of Dr. H. J. Bhabha, F.R.S. It is hoped that it will be possible to fill in some of the more vital gaps in our knowledge of the penetrating component mentioned above by experiments carried out in the laboratory of the Unit and by high altitude balloon flights as well as by mathematical investigations. It would be pointless to ask a cosmic ray physicist to-day of the possible applications of his work, for he is still in the stage in which Maxwell found himself when he formulated his equations. Nevertheless it can be confidently said that a complete understanding of the phenomena of cosmic rays will have the most far-reaching effects in our understanding of some of the most remote problems of the structure of the universe on the one hand, and open up realms at present undreamt-of for the benefit of humanity on the other. Indeed, it is held by some scientists that the mutations upon which all biological evolution depends are stimulated by cosmic rays, so that it is not beyond the realm of possibility that the very process of animal and human evolution may depend on the existence of cosmic rays. At the present rapid rate at which science progresses, we may hope that in another ten or fifteen years the entire field of the purely scientific aspects of cosmic rays will have been investigated and that we will be in a position to think of the application of the knowledge so obtained to practical purposes.

WOOD AS A MATERIAL OF CONSTRUCTION

THE present scarcity of metals has focussed attention on the possibilities of timber as a substitute material. And substitutes have a habit of coming to stay. This possible outcome of what at present is forced war-time economy is to be welcomed because timber, quite apart from the shortage of other materials of construction, has received all too little attention in this country. One needs to be reminded that the very word "timber" tells a tale—being derived from Greek and Latin roots meaning "to house", "to build". And while the utilisation of timber as a material of construction and also as a source of food, drink and clothing, as a source of energy and as a source of raw material for a bewildering range of processing chemical industries has made phenomenal advance in other countries, we in India have for the most part not kept pace with these developments. An index of our backwardness in this respect is well provided by our almost complete dependance on imports (which at present are very much restricted) even for such a comparatively simply processed wood product as plywood.

The chief reasons for this state of affairs are our innate conservatism coupled with our ignorance until very recently of even the basic properties of Indian timbers. It was easier to import. And as a direct result of the propaganda on behalf of other materials of construction these latter actually made inroads into even the limited fields where timber thereto held sway. In India, unlike for example in the U.S.A., the Government happen to be the principal owners of timber and in the nature of things could not keep up the same kind and amount of sustained and subtle forms of publicity which competitive materials with powerful interests behind them put forth for the favour of the consumer. It was, therefore, inevitable that timber not only did not make any headway but actually lost ground as a material of construction.

Added to these was another factor which is not peculiar to this country. This may best be described as the psychological factor; for example, such a statement as "timber is not strong" would appear in quite a different light when the weight-strength ratio is considered—weight for weight, a timber could actually be "stronger" than some metals. But this needs to be said and said loudly and often. Again, the drawback alleged to timber that it is not permanent loses much of the point in the light of the modern concepts of economic permanence—that no component of a structure need outlive the usefulness of the structure itself. Anyway, modern methods of preservation have very greatly prolonged the "life" of timbers. Again, while it is true that timber is combustible, it does not follow that it is necessarily the first to give way in any actual fire; metals may also fail at temperatures that are encountered in "fires". And economic processes have been evolved which make timber if not fire-resistant at least fire-retardent. Enough has been cited to indicate the nature of the misconception and half truths associated in the popular mind with timber. Such prejudice and ignorance have been combated in other countries by the twin weapons of educating the public, on the one hand, on the truth about timber and its limitations, and on the other by sustained research which tries to exploit to the utmost the characteristic properties of wood, and, yes, even to improve upon nature by appropriate modifications. The courses on timber engineering in some of the continental engineering colleges and the Timber Development Association in England are classical examples of the first approach to this problem while "Masonite", metal-faced plywood, and "Teco" timber connectors stand out as monuments to recent research in timber.

No greater harm could be done to the cause of timber utilisation than to claim that all timbers are good for every purpose. Timber is not ductile; it splits easily along the grain; it is not hard enough for some purposes. These are some of the major limitations that must be squarely faced. But, timber is light, easily worked with simple equipment to different shapes, easily fastened together, has a comparatively high salvage value and is a poor conductor of heat and electricity, and is susceptible to a minimum corrosion. This is a very valuable combination of properties in a material of construction quite apart from the æsthetic aspect which can, as in interior decoration, become an all-important matter. Timber could be finished to give a variety of attractive effects, while the grain, texture and figure of timber render possible decorative schemes which, for individuality and variety are hard to beat. In short, from the æsthetic point. timber has almost a personality of its own.

There are certain other features in timber utilisation which are of importance in our country. Timber is the material *par excellence* for construction by the villager. Thus, for example, the low first cost and easy workability of timber must be exploited to the utmost in the solution of our rural transport problem. In these areas, the traffic does not warrant the heavy outlay on steel bridges to span the innumerable streams which often maroon entire villages. Treated, preframed timber bridges would offer a solution. Suitable type designs could be prepared; and the small timber members going into such a structure could generally be had in the neighbourhood of the site itself. The carpentry and the labour for erection could be provided by the village community itself. The preservative material and the fasteners are the only materials to be "imported". Unlike in steel construction, the greater part of the material and labour would be indigenous and thus contribute largely to its total low cost, and keep even this little money within the community. If the traffic should develop beyond the capacity of such a modest structure, or at the end of its normal life—which need be no more than ten to fifteen years—*another* bridge could easily be built.

In India, institutions designed and devoted to timber research are woefully few. And these few are doing pioneer work, often against odds. They can no more than touch the fringe of the problem. But, their work has already succeeded in putting some "condemned" species on the utilisation map of the country. Such, for example, is the gradual replacement by indigenous timbers of imported ash and hickory handles. They have done a great deal to educate the public on timber preservation. They have also been directly responsible for the starting of a few timber industries. This should be viewed as no more than a promise of what could be done. Japan, for example, has transformed the humble bamboo into a prime constructional material. The same can and must be done for Indian timbers. Unlike in temperate climates, the number of species in Indian forests are bewildering and neither are the crops homogeneous. The country is so vast that not only do the species differ from region to region but the properties of the same species vary according to its habitat. These complications necessitate sustained research in laboratories devoted to forest products and strategically located all over the country. The work of these institutions has to be planned and translated into industrial practice through a *liaison* agency. And finally the innate conservatism of the consumer and any of his prejudices against timber must be combated by intelligent and sustained propaganda coupled with readily available instruction on the most effective and modern methods of using timber. Such a planned programme does involve considerable outlay. Experience in other countries has proved such expenditure to be good investment. There is no reason to believe that it would be otherwise in India.

MR. D. N. WADIA, M.A., B.Sc., F.G.S., F.R.A.S.B., F.N.I.

We have very great pleasure in announcing the award, by the Council of the Geological Society of London, of the Lyell Medal to Mr. D. N. Wadia, Government Geologist, Ceylon. According to the conditions of the 'Lyell Geological Fund', this Medal is awarded annually by the Geological Society "as a mark of honorary distinction and as an expression on the part of the Governing Body of the Society that the Medallist has deserved well of the science", and the award of this medal to Mr. Wadia this year is an honour which he richly deserves. Mr. Wadia is well known as one of the foremost Indian geologists in the country, and both as a teacher of Geology as Professor in the Prince of Wales College at Jammu, and later, as an active and enthusiastic field geologist on the staff of the Geological Survey of India, Mr. Wadia has contributed in no small measure to the promotion and progress of geological studies in India. Apart from this, he has all along taken considerable interest and played a prominent part in the work of the various scientific bodies in India, in recognition of which honours and distinctions have been freely conferred upon him. Ever since its inception, *Current Science* has been fortunate in securing Mr. Wadia's wholehearted support and co-operation; and we take this opportunity of offering him our sincere felicitations on the signal honour that has now been conferred upon him by the Geological Society of London. We wish Mr. Wadia many more years of active service in the cause of science in India.

OBITUARY

SIR BRYCE CHUDLEIGH BURT, Kt., C.I.E., M.B.E., B.Sc., I.A.S. (Retd.)

WE very much regret to record the death of Sir Bryce Burt, retired Vice-Chairman of the Imperial Council of Agricultural Research in England in January 1943 at the age of 62.

Sir Bryce was born in April 1881 and graduated from the University College, London, in 1901 with first class Honours. While a student in the University, he was a Clothworker's Exhibitioner in Chemistry. After graduating he was for a couple of years (1902-1904) assistant lecturer in Chemistry at the Liverpool University. From 1904-1907 he was at Trinidad, British West Indies, as assistant Government Chemist and lecturer in Tropical Agriculture. He joined the Indian Agricultural Service in India in January 1908 and was posted to United Provinces as Deputy Director of Agriculture and this post he held for a period of thirteen years until 1921. During this period for a term of three years (1912-1915) he did the duties of the Director of Industries of the Province also in addition to his agricultural work. When the Indian Central Cotton Committee was constituted in 1921, he was appointed its first Secretary, which post he held for seven years, until 1928. After this he was appointed for the short period of a year Director of Agriculture in Bihar and Orissa and was later appointed the first Agricultural Expert to the Imperial Council of Agricultural Research (since changed into Agricultural Commissioner to the Government of India) when it was started. He acted for two short periods as Vice-Chairman of the Imperial Council of Agricultural Research and became the permanent Vice-Chairman in October 1935 when Sir T. Vijayaraghavacharya retired. In 1932 he went to Ottawa for five months as the official Adviser to the Indian Delegation to the Imperial Economic Conference. Later, he was one of the Advisers to the Indian Trade Delegation in 1937. He retired and left India in April 1939 after thirty-one years of service and having reached the highest post open for a person belonging to Indian Agricultural Service. After retirement, when war started in September 1939, he joined the Food Ministry and was working in it as the Director of Animal Feeding Staff until the time of his death.

One outstanding feature of Sir Bryce Burt was his organising capacity with a mastery of details and this was apparent from his work, particularly in the two new bodies, the Indian Central Cotton Committee and the Imperial Council of Agricultural Research. He was a man of extraordinary energy and his knowledge of things was encyclopœdic which was the result of his varied activities in the early years of his service. People who had worked with him in U.P. in the early years used to say that Burt was always a busy body, would never spare himself nor let others associated with him take things easy. To quote the words of the reviewer of his career in India when he retired from service in 1939, "Probably no single man has so deeply influenced Indian Agriculture in so many directions as Sir Bryce Burt did". The setting up of the agricultural marketing organization and the promotion of technological research directed to elucidating the factors determining quality in agricultural products might be said to be two of the outstanding features of his activities.

As Chairman of the Imperial Council of Agricultural Research, he was *ex-officio* Chairman of so many bodies, namely, the Indian Central Cotton Committee, the Indian Central Jute Committee, the Indian Lac Cess Committee, the Indian Coffee Cess Committee, and both wings of the Board of Agriculture and Animal Husbandry in India. He took great interest in the development of Soil Science and was largely responsible for starting the Indian Society of Soil Science. He was a foundation fellow of the National Institute of Sciences in India and one of the Editorial Co-operators since the

inception of *Current Science*. He was a familiar figure at the various sessions of the Indian Science Congress Association and was the President of the Agricultural Section in 1924.

By his vast knowledge of things connected with every branch of Agricultural Science, he commanded the esteem and regard of all the Agricultural Officers throughout India. He was always a sound judge of men and was easily approachable and kind to the junior Agricultural Officers. Anyone who went to him for consultation and discussion always returned with additional knowledge to his benefit.

Government was not slow in recognising the value of his work and honours bestowed on him were numerous—Kaiser-i-Hind Medal in 1912, M.B.E. in 1919, C.I.E. in 1930 and Knighthood in 1936.

We offer our condolences to Lady Burt and the family of late Sir Bryce Burt.

MR. V. S. SAMBASIVA IYER, B.Sc., L.C.E.

WE regret to report the death, on 10th January 1943, at Madras, of Mr. V. S. Sambasiva Iyer, retired Professor of Geology, Central College, Bangalore. After passing the B.Sc. and L.C.E. examinations of the Bombay University, Mr. Sambasiva Iyer joined the Mysore Geological Department as one of the Probationers and soon rose to the position of Assistant Geologist. He was appointed Professor of Geology in the Central College in the year 1914, which post he held till his retirement in 1920. Even after his retirement from official service he continued to be an active field geologist and took a prominent part in the development of the mineral resources of South India. By his pleasant and amiable disposition and his unostentatious and simple habits, he had endeared himself to all his students, friends and colleagues alike.

RESEARCH PAYS

RESEARCH pays in hard, cold cash, Eugene Ayres of the Gulf Research and Development Company told the meeting of the American Chemical Society recently. He explained a numerical yardstick which he has developed, which gives an estimate of the differences in costs between industrial processes put into operation without waiting for preliminary experimentation and those that are given the benefit of research in laboratory and pilot plant, together with proper patent procedures, before they are started. If a given industrial problem is carried through all three steps of research, patent procedures and pilot plant experiments, the total cost of "make-ready" is considerably less than half that involved in rushing into full production without the preliminary steps. How necessary the pilot-plant stage is also shown up in the table. With laboratory research and patent procedure, but omitting pilot plant the costs were substantially greater than those of complete preparation, though still substantially less than those of no preparation at all. Mr. Ayres cited the case of a company that found it necessary to go into the manufacture of a new chemical in a hurry: "There were no large-scale precedents for this operation, but two good process ideas were offered by the Research Department. Because of the emergency, it was decided to commercialise one idea without any research while the second idea was carried in orderly fashion through laboratory and pilot plant. Despite the delay occasioned by months of research, the second idea resulted in a smoothly operating plant before the first and at much lower development cost. The first idea was then sent back to the Research Laboratory and a year later superseded the second."—FRANK THONE.

(Courtesy of *Science*, 1942, 96, 14.)

LETTERS TO THE EDITOR

EFFECT OF HIGH-FREQUENCY VOLTAGE ON DIELECTRIC CONSTANT OF SPACE CONTAINING ELECTRONS

PRASAD AND VERMA[1] while investigating the applicability of Eccles-Larmor expression for the dielectric constant of electronic medium inside a Phillip A 442 Valve observed that the dielectric constant of such a medium depended upon the magnitude of the impressed high-frequency voltage, the anode and the screen-grid of the valve forming the plates of the experimental condensor. They observed that there was a parabolic relation between the change of capacity of the experimental condensor and the magnitude of the high-frequency voltage. Khastgir and Choudhury[2] also noticed this dependence, but did not confirm this parabolic relationship. Khastgir suggested that the observed effect was due to the fact that the effect of high-frequency voltage is to alter the amplitude of the electrons in the anode screen-grid space. For smaller values of voltage, electrons may not be able to reach the anode surface and for such conditions the conductivity of the space must be small and hence the equivalent shunt resistance high. With the increase of high-frequency voltage, this resistance would gradually fall and after some time, it will come to a constant value. As the effective change of capacity depends upon the conductivity of the space, the variation of the latter will explain the experimental results.

The present work was undertaken to study the subject in greater detail with a view to clarify the exact reason leading to this dependence. This was considered desirable specially in view of the fact that there is no room for the magnitude of high-frequency voltage in Eccles-Larmor expression. The present author has repeated the experiments of Prasad and Verma by using the same method with some improvements taking into account conductivity corrections. He has not been able to obtain any parabolic variation and the experimental curves obtained by him are essentially of the same type as those obtained by Khastgir and Choudhury. One typical graph is given in Fig. 1.

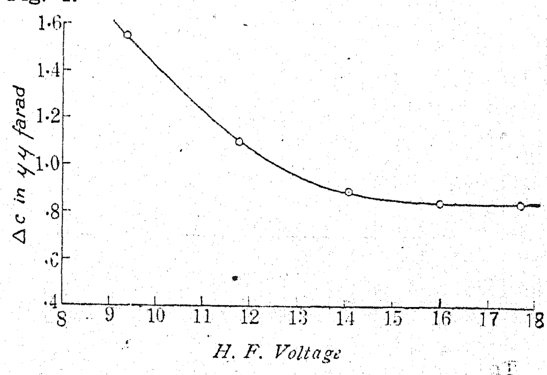


FIG. 1

λ 110 metres. $i = 125 \times 10^{-6}$ amp.
Phillips B 442 valve

It is noticed that the anode current alters with the change in the magnitude of the high-

frequency voltage. As the high-frequency voltage gradually increases, the anode current also gradually increases until a stage comes when there is no further change in the current with the increase of high-frequency voltage. The nature of variation is shown in the graph given in Fig. 2.

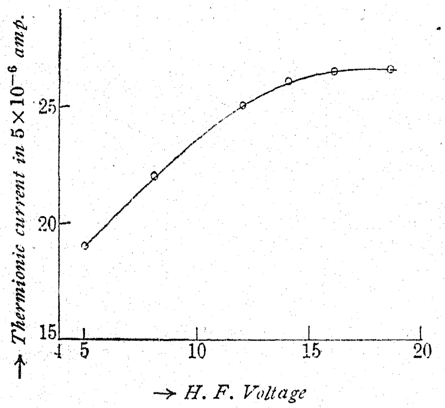


FIG. 2

Variation of Thermionic current with H. F. Voltage

Thus it seems likely that there is no dependence of dielectric constant on the high-frequency voltage, but the effect observed is of a secondary nature. The high-frequency voltage alters the magnitude of the anode current, but in our experiments and those of previous workers, the anode current was maintained constant by altering only the filament resistance. This procedure certainly altered the effective value of the electronic concentration between the condensor plates. This fact is further strengthened by the observation that the thermionic current begins to assume constant value at that high-frequency voltage where the change of capacity tends to become constant (compare Fig. 1 and Fig. 2).

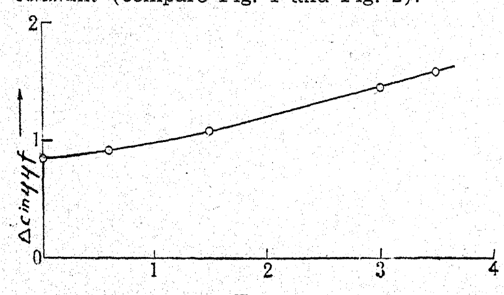


FIG. 3

Change in Thermionic current (in 5×10^{-6} amp.) due to application of H. F. Voltage

To bring out the relationship more clearly Fig. 3 has been drawn between the change of thermionic current due to impressed High Frequency Voltage and the change of capacity observed. The figure reveals that at least partially the observed change in capacity is due to change in electronic concentration consequent upon the introduction of High Frequency Voltage.

In conclusion the author thanks the Government of Bihar for the kind award of a scholarship during the tenure of which this piece of work was undertaken. The author is also thankful to Prof. S. P. Prasad and Dr. B. N. Singh for constant help and guidance throughout the investigation.

Physics Laboratory,
Science College, Patna, SNEHMOY GHOSH.
January 1, 1943.

1. Prasad and Verma, *Zeits. f. Physik.*, Band **99**, **7** and 8 heft, 107. 2. Khastgir and Choudhury, *Indian Journal of Physics*, 1940, **14**.

THE RARE OCCURRENCE OF MELILITE-DIOPSIDE-NEPHELINE ASSOCIATION IN A CALCIPHYRE, NEAR NANJANGUD, MYSORE

IN my present detailed studies of the Charnockite rocks in Mysore, while re-examining the micro-sections of some specimens of re-crystallised calc-granulites (Caliphyres) I had collected near Nanjangud in 1923, I recently noticed in one of them a mineral—which, from its optical characters and micro-chemical tests—I recognise as Melilite. A careful examination of the several specimens I had previously collected in the area discloses that Melilites, of varying optical characters, occur in a narrow band of garnetiferous-hornblende diopside granulite,—a component of a thin composite series of calc-granulites which are injected and veined by a later set of pegmatite. Melilites—presumably of varying composition—where found, are intimately associated with diopside, or zoisite and epidote; and are seen either as separate stout laths or in intergrowth with the one or the other of its associated minerals. One of the specimens of these granulites discloses in addition, large plates of nepheline enclosing, poikilitically, several coarse grains of diopside and granular sphene. Scapolite, lime, alumina, garnet, sphene, epidote, and some unidentified rare types of lime silicate minerals are also found in some of the specimens of highly calciferous types.

The occurrence of Melilite and Nepheline in these Calciphyres, is not only of great interest as the first recorded discovery of these minerals in Mysore, but their close association with diopside would throw some light on their paragenesis and on the mode of origin of the melilite rocks which, at least so far as this area is concerned, seem to have been formed from re-actions between an older impure dolomitic limestone and the later injected alkalic liquids connected with the granitic intrusions of the region. A full description of these melilite-bearing rocks, which are still under a detailed study, will be given in Volume XLI, *Records of the Mysore Geological Department*, which will be published in the course of a few months.

Mysore Geological Dept.,
Bangalore, B. RAMA RAO.
January 27, 1943.

A NOTE ON THE WIND-BORNE DUST COLLECTED IN THE MONTH OF MAY 1942

DUST STORMS had been particularly heavy in Delhi in May 1942 and a deposit during the last week, on a 20 cm. × 20 cm. glass plate weighed 12·45 gm. with an apparent volume of 11·3 c.c. The sample was collected and subjected to chemical and mechanical analyses. It was seen from the results that the dust had been mainly sand with a small amount of clay and had very little organic matter. The chemical composition suggested that the dust was soil from an extremely arid zone:—

Mechanical analysis: Coarse sand—31·92%, Very fine sand—53·00%, Silt—13·34%. Clay—2·74%.

Chemical analysis: Insoluble residue—84·83%. Fe_2O_3—4·21%, Al_2O_3—4·06%, CaO—1·43%, MgO—1·12%, K_2O—0·66%, Na_2O—1·20%, Organic matter—0·64%.

pH of the dust as determined colorimetrically was 8·2. Analysis of the water extract (1:5) suggested the following percentage composition. for the mixture of soluble salts. Total salts—0·2000, $CaCO_3$—0·0025, $Ca(HCO_3)_2$—0·0689, $CaSO_4$—0·0238, $MgSO_4$—0·0142, NaCl—0·0846.

Dust collected at different periods during summer of 1942 had practically the same mechanical composition. Chemical analyses were not carried out. The sample of dust was very similar to the so-called "dust soils" of the arid regions of the United States of America and examined by Hilgard.* These soils have been described to be "so loose and fine as to rise in clouds at the merest puff of wind", during the dry season.

My thanks are due to Dr. S. V. Desai and Mr. A. C. Ukil for many valuable suggestions.

Imperial Agric. Res. Institute,
New Delhi, ABHISWAR SEN.
February 3, 1943.

* Bull. No. 3, Weather Bureau, U.S. Dept. of Agriculture, 1892, quoted in *A Treatise of Rocks, Rock Weathering* and *Soils*, 1897, 345, by G. P. Merrill.

*REPORT ON THE OCCURRENCE OF *SIREMBO IMBERBIS* TEM. AND SCHL.,[1] FROM INDIAN WATERS TOGETHER WITH A NOTE ON ITS PYLORIC CÆCA

WHILE working on the pyloric cæca of Indian fishes, I came across a Brotulid fish in the general collection of the Biological Station (Ennur), Madras Fisheries Department. As the fish was quite new to me and also as I was unable to identify it owing to lack of literature, it was sent to Dr. J. R. Norman of the British Museum, who identified it as *Sirembo imberbis* Tem. & Schl.[2] He also pointed out that it has been reported from Japan and once from Chinese waters, and is a deep sea fish; there was no report of its occurrence in the Indian waters. The last statement was corroborated by Dr. Hora also.

As is well known, Madras fishermen on the east coast (Bay of Bengal) use catamarans and do not go very far out for catching fish, the utmost limit being ten miles from the shore and depth twenty fathoms; thus they fish in comparatively shallow waters only. For the Biological Station at Ennur, the fishes are collected from the catches of the fishermen and preserved. The fish under report must have belonged to such a general collection and was, therefore, not caught from deep waters. From the number of specimens examined by me in the collection of the Biological Station, the fish does not appear to be very rare in these waters.

I have examined and dissected a dozen fishes and note below the colouration of specimens preserved in formalin:—

Dorsal surface and sides brown, with four to five dark-brown longitudinal bands on the sides running more or less parallel to one another. Ventral side slightly brown. Dorsal fin with two black and three brownish-black spots on the margin not reaching the base; rest of the dorsal and anal have a blackish margin. Pectoral brownish, without black fringe.

The number of pyloric cæca varies from 13 to 15, but usually the number is fifteen. They are bilaterally arranged in linear series, *i.e.*, on the right and left of the proximal part of the duodenum immediately after the pylorus, and have independent and separate openings into the former, usually six cæca being present on the right and nine on the left side. They are tubular structures somewhat tapering towards their free ends (Text-Fig. 1).

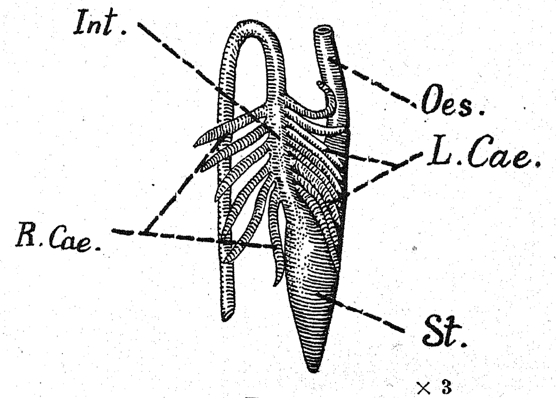


FIG. 1

Viscera of *Sirembo imberbis* Tem. and Schl., showing the disposition of the cæca

Oes.—Oesophagus; *L.Cæ.*—Cæca of the left side, *St.*—Stomach; *R.Cæ.*—Cæca of the reght side; *Int.*—Intestine.

I am greatly indebted to Dr. B. Sundra Raj and Dr. D. W. Devanesan for affording me an opportunity of working on this fish. For the

* A detailed note on the systematic position and its distribution will be published by Dr. B. Sundra Raj.

Published with the permission of the Additional Revenue Secretary (Rural Reconstruction), H.E.H. the Nizam's Government, Hyderabad (Deccan).

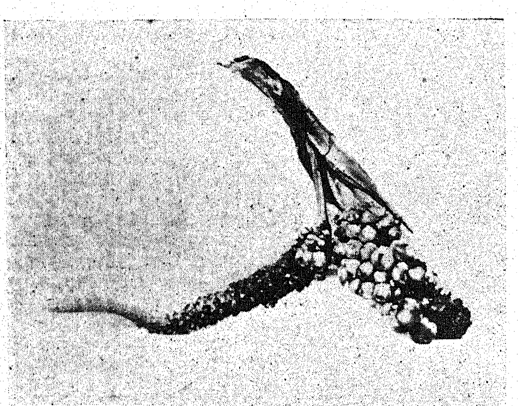
identification of the material, I am grateful to Dr. J. R. Norman of the British Museum and to Dr. S. L. Hora of the Department of Fisheries, Bengal, for the supply of literature.

Department of Fisheries,
H.E.H. the Nizam's Government,
Hyderabad (Dn.), M. RAHIMULLAH.
January 1, 1943.

1. Norman, J. R., "The John Murray Expedition, 1933-34" *Scientific Reports*, 1939, **7**, No. 1. 2. Gunther, A., *Cat. Fish. Brit. Mus.*, 1862, **4**, 373.

A NOTE ON *BORASSUS FLABELLIFER* LINN.

Borassus flabellifer Linn. is described as a tall diœcious palm in systematic accounts.[1] Blatter[2] describes it as a "very tall diœcious palm" and does not refer to any exceptions. But monœcious trees of *Borassus* seem to be common. The monœcious inflorescences are observed to be produced by some trees regularly year by year. The photograph published is that of



Monœcius spa.ix of *Borassus flabellifer* Linn.

such an inflorescence, observed by the writer, where one branch of the spadix (right) bears only female flowers and the other (left) bears female flowers at the base and male flowers towards the tip, where the branch shows a deflection.

The unisexual condition in this genus seems to be derived by reduction from hermaphrodite flowers, the female flowers containing 6-9 staminodes and the male flowers containing a pistillode represented by three bristles.

Botany Department,
P. R. College, Cocanada, V. VENKATESWARLU.
January 14, 1943.

1. Hooker, J. D. Sir, *The Flora of British India*, 1894, **6**. 2. E. Blatter, S.J., "The Palms of British India and Ceylon, Indigenous and Introduced, Part VII," *The Journal of the Bombay Natural History Society*, 1912, **21**, No. 3.

EXCITATION AND ACCOMMODATION IN UNSTRIATED MUSCLE

WHEN unstriated muscle is stimulated with alternating current (A.C.), the tension soon subsides owing to accommodation (Singh, 1938).

This phenomenon is analogous to that described by Hill (1936) in nerve. Using his terminology the tension subsides when "U" rises above "V", their rise being visualised as in Fig. 1. When the muscle is stimulated with A.C., two factors produce their effects, one that retards relaxation, and the other that produces tension. These two factors are not the same, as shown by the fact that the muscle accommodates to the two at different times; the two factors are antagonistic. Using 8 volts, A.C., the relaxation is retarded if the duration of the contraction is approximately less than 3-4 seconds; accommodation to tension takes longer, about 5-7 seconds. The primary tension is probably produced by ions inside, and retardation of relaxation by ions; outside (Singh, 1938,[3,4,5,6,7,8] Singh, 1939,[9,10] Singh

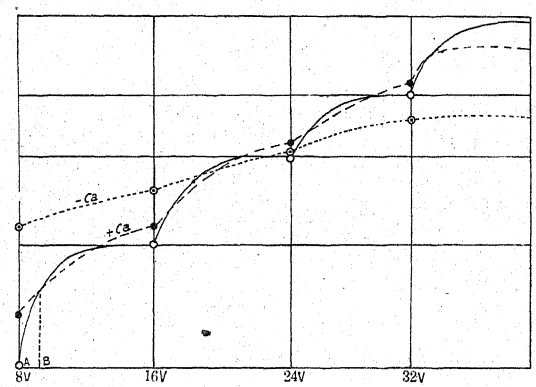


FIG. 1. Unstriated muscle. Rise of "V" (continuous line) and rise of "U" (discontinuous lines) In the absence of calcium the initial threshold rises but the rate of rise is less (Singh, 1938*d*). Ultimately "U" may begin to fall, owing to "adaptation to adaptation" or "accommodation to accommodation".

1940,[12,13]; Singh, 1942, 1943,[14,5] Rao and Singh, 1940). The above results show that "U" rises more slowly than "V".

When the stimulus is over, fatigue persists to A.C., and potassium for sometime, and tone also is neutralised for 3-4 secs. This shows that the fall of "U" is slower than that of "V"; the primary tension is probably produced by ions inside and tone and the potassium contraction by ions outside.

The interval from A to B, that is, the latent period, is the time required by "V" to catch "U" as suggested by the fact that potassium and magnesium which increase accommodation in nerve, increase the latent period of certain contractions in Mytilus muscle.

Ultimately "V" rises higher than "U" as shown by the fact that with higher voltages continuous tension is produced, and the rate

of relaxation is decreased. Ultimately, however, "U" may fall owing to "accommodation to accommodation" or "adaptation to adaptation".

Brigade Laboratory,
Allahabad, INDERJIT SINGH.
January 18, 1943.

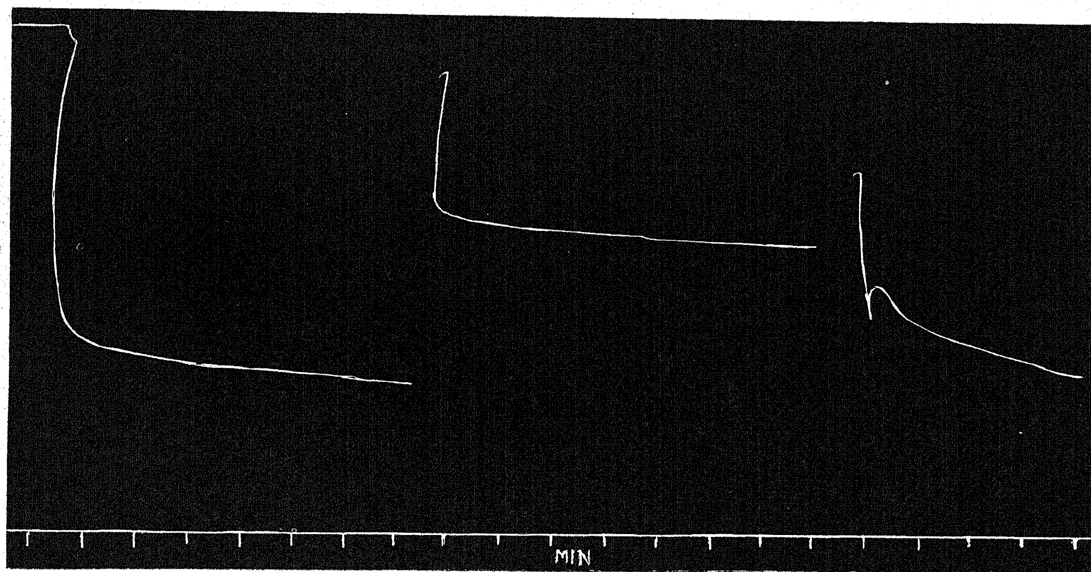
1. Hill, A. V., *Proc. R. Soc.* 2. Rao, M. S., and Singh, I., *J. Physiol.*, 1940, **98**, 12. 3. Singh, I., *Ibid.*, 1938, **91**, 398. 4. *Ibid.*, 1938, **92**, 62. 5. *Ibid.*, 1938, **92**, 232, 6. *Ibid.*, 1938, **94**, 241. 7. *Ibid.*, 1938, **94**, 1. 8. *Ibid.*, 1938, **96**, 367. 9. *Ibid.*, 1939, **96**, 1. 10. *Ibid.*, 1939, **96**, 367. 11. *Ibid.*, 1940, **98**, 155, 12. *Ind. J. Med. Res.*, 1942, **30**, 449. 13. *Ibid.*, In the Press. 14. *Proc. Ind. Acad. Sci.*, 1943, In the Press. 15. *Ibid.*, In the Press.

THE CONTRACTION OF UNSTRIATED MUSCLE PRODUCED BY CHANGE OF TENSION

UNSTRIATED muscle is known to contract on sudden increase of length (Straub, 1900; Winkler, 1898; Singh, 1938). Singh (1938) has shown that unstriated muscle not only responds to increase but also decrease of tension or length, so that like other stimuli, it is the change of state that excites the muscle. Further this contraction has properties of the potassium contraction.

The contraction produced on stretch has been ascribed to nervous activity (Ferguson, 1942). I am not inclined to agree to this, as the potassium contraction is increased by agencies that paralyse nerves, such as, chloral hydrate, ether, curare, novocaine, nicotine. Fig. 1 shows stretch contraction produced in the presence of 0·1 per cent. nicotine. When I first noticed the stretch response in Mytilus muscle, I thought it was due to nervous activity, so I used chloral hydrate to abolish it, but I found that the latter augmented the response.

The absence of the stretch response in nerve-free smooth muscle is no indication that it is produced by nerves. It is not always found in Mytilus muscle, and I have not found it in frog stomach which contains nerves. Its presence depends on the action of ions outside, and also on the rate of stretching. Calcium increases this accommodation in Mytilus muscle. The fact that contraction is produced both by stretch and release suggests that it is due to a certain configuration of the myosin molecule through which the muscle passes as its length is changed either way, this configuration being distorted by accommodation. Changing the length of the molecule probably produces orientation of the bonds, so that the molecule becomes polarised, and difference in potential is produced between parts of the molecule.



The effect of nicotine (0·1 p.c.) on the stretch response

Curve I in Mytilus saline Curve II in Acetylcholine (1 in 10^5)

Curve III in Acetylcholine + nicotine. Note the stretch response.

Brigade Laboratory,
Allahabad, INDERJIT SINGH.
January 18, 1943.

1. Ferguson, J., *Amer. J. Physiol.*, 1942, **131**, 524. 2. Singh, I., *J. Physiol.*, 1938, **92**, 62. 3. Straub, W., *P. Fluger's Arch.*, 1900, **79**, 379. 4. Winkler, H., *P. Fluger's Arch.*, 1898, **71**, 357.

A NOTE ON THE OIL FROM THE FRUIT OF *BALANITES ROXBURGHI*

Balanites Roxburghi (N.O. Simarubeæ) is a small thorny tree whose seeds, bark and leaves are used as indigenous drugs [*vide* (*i*) *The India Materia Medica*, by K. M. Nadkarni, p. 97; (*ii*) *Nighantu Adarsha*, by Vaidya Bapalal Garbaddas Shah, p. 225; (*iii*) *Dictionary of the Economic Products of India*, by Watts, Vol. I, p. 363].

The fruit of this tree is oval, of a yellowish colour (when ripened), composed of a sweet but disagreeable pulp surrounding the stone. The pericarp content of the fruits is about 30 per cent. The remaining stone consists of seed kernel and a stout shell which is largely employed in the preparation of indigenous fireworks. The kernels of the seeds on extraction with petroleum ether yield about 43 per cent. oil of an almost yellowish colour. The oil has a faint odour and shows the following characteristics.

Refractive Index at 40° C. = 1·4623, Saponification value = 195·20, Acid value = 0·575, Acetyl value = 31·75, Iodine value (Wiji's method) = 88·30, Unsaponifiable matter = 2·92.

The examination of the component fatty acids of the oil is in progress.

The pericarp of the fruit which is used as a detergent to clean silk and cotton textiles yields profuse lather and is under investigation.

Industrial Chemist's Laboratory,
Sayaji Technological Institute,
Baroda,
January 20, 1943.
C. B. PATEL.

CHEMICAL INVESTIGATION OF HAIRS FROM THE MEDICO-LEGAL STANDPOINT

THE examination of hairs and fibres upon weapons, in blood or other stains, upon the clothing or person of the victim or assailant or at the scene of a crime is of great medico-legal importance, for by such investigations significant clues may be discovered and definite links in a chain of evidence may be established. The first point which an expert has to decide is whether the particular hair is human hair or that of a particular animal. At present, opinion on the point is given only on the basis of microscopical examination. One has to rely mainly on the anatomical characters of the various parts of hairs, *i.e.*, on the size and appearance of the medulla, cortex and cuticle. It was, therefore, thought desirable to discover some independent method for distinguishing between hairs of different animals. Exploratory experiments with about thirty different reagents were tried and it was found that the action of (1) chlorosulphonic acid, (2) nitric acid, (3) 5 per cent. solution of potassium dichromate and (4) caustic alkalis, is of diagnostic value.

Before microscopical examination, hairs must be cleansed. Hairs smeared with blood, etc., are best cleansed by treating them first with 5 per cent. potassium cyanide solution, followed by water and alcohol-ether mixture. The structures of thick or dark hairs are best brought out by the action of 5 per cent. potassium dichromate solution (in acid medium) or strong nitric acid. Nitric acid is quicker in action and generally clarifies the structure in about five minutes, but it has also a dissolving action. Five per cent. dichromate solution, although slower in action, is of greater diagnostic value—the hairs of different animals requiring different times for decolourisation, the time taken depending upon the colour and thickness of the hair. Details of these experiments will be published elsewhere.

The above two reagents were found to be much superior clearing agents than hydrogen peroxide, which is usually used for this purpose.

Attempts were made to discover (1) such reagents as would dissolve some animal hairs, but not others, (2) reagents which would take different times in dissolving hairs of different animals, (3) reagents which would gelatinise or disintegrate different hairs in different times. *Chlorosulphonic acid* disintegrates the hairs, the action starting first with the cuticular scales. These scales swell up, the cuticular and medullary pigment getting decolourised. Prolonged treatment completely disintegrates the hairs into cuticular and medullary fragments. It was found that the hairs of the horses, goats and pigs require longer time for complete disintegration than the hairs of other common animals. *Caustic alkalis* gelatinise the hairs and dissolve them in a short time. They soften the hairs even in the cold and hence a preliminary treatment with 10 per cent. caustic soda solution in the cold for about ten minutes is very helpful in taking cross-sections of the hairs. With 20 per cent. caustic potash solution, the time taken for complete gelatinisation of the hairs varied from half minute to three minutes and the time taken for complete dissolution varied from four to ten minutes.

A detailed account of the action of the various reagents on hairs of different animals and an account of the investigations on the effect of age on hair is reserved for a future communication.

Chemical Examiner's
Laboratory, Agra,
September 14, 1942.
S. N. CHAKRAVARTI.
S. N. ROY.

REVERSED POLARITY IN THE EMBRYO-SAC OF *HEPTAPLEURUM VENULOSUM* SEEM

CASES of reversed polarity in the embryo-sacs are rare. Schnarf[1] (1931) refers to only four cases, (1) *Rhopalocnemis phalloides* (Lotsy, 1901), (2) *Lindelofia longiflora* (Svensson, 1925), (3) *Fuchsia marinka* (Tackholm, 1915) and (4) *Atamasco texana* (Pace, 1913). Three more cases have recently been added from India to the list of such forms. Dutt and Subba Rao[2] (1933) recorded a probable case of embryo-sac reversal in *Saccharum*. Joshi and Venkateswaralu[3] (1935) noticed a single case of embryo-sac reversal in *Woodfordia*

floribunda collected near Kumaon. Thirumalachar and Basheer Ahmad Khan[4] (1941) recorded the same feature in *Eriodendron anfructosum.*

During the course of embryological studies on the Araliaceæ the author noticed a single case of embryo-sac reversal in *Heptapleurum venulosum* Seem, which is an interesting record for that family. The egg apparatus was situated at the chalazal end, the synergids showing prominent basal vacuoles. The antipodals are

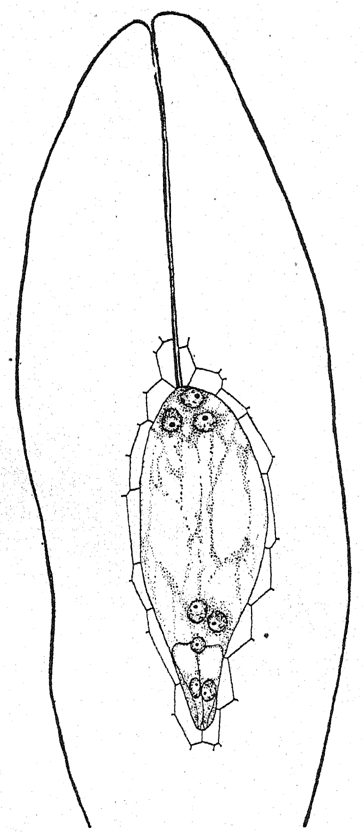


FIG. 1

Showing reversed polarity of the embryo-sac. × 570

sometimes cellular, in normal cases, situated in a chalazal pouch. In the embryo-sac with reversed polarity, the egg apparatus was organised in the chalazal pouch. The three nuclei at the micropylar end remained as such without becoming cellular.

Joshi and Venkateswaralu (1935) in their account of the embryo-sac reversal in *Woodfordia floribunda* state that it was the first clear case of reversed polarity observed in an eight-nucleate embryo-sac. In *Lindelofia longiflora* where Svensson records reversed polarity, the antipodals were absent. In *Eriodendron anfructosum* also the antipodals show early degeneration. The lack of antipodals in these forms due to early degeneration which is characteristic of the form should not preclude them from being recognised as normal eight-nucleate embryo-sacs. Only in *Atomasco texana* appreciable numbers of embryo-sac reversals are known, and the single cases noticed in *Woodfordia, Eriodendron, Heptapleurum* and others are abnormalities probably without any significance.

Thanks are due to Dr. L. N. Rao for his guidance.

Bangalore,
January 10, 1943. D. M. GOPINATH.

1. Schnarf, K., *Vergleichende Embryologie der Angiospermen*, 1931. 2. Dutt, N. L., and Subba Rao, *Ind. Jour. Agri. Sci.*, 1935, **3**, 37–56. 3. Joshi, A. C., and Venkateswaralu, J., *Ann. Bot.*, 1935, **59**, 841–43. 4. Thirumalachar, M. J., and Basheer Ahmad Khan, K. *Proc. Ind. Acad. Sci.*, 1941, **14**, 461–65.

SPORE-GERMINATION OF *GANODERMA LUCIDUM* (LEYSS.) KARST.

Ganoderma lucidum (Leyss.) Karst. is a cosmopolitan species, growing as a saprophyte as well as a wound-parasite on a large number of hosts. After repeated attempts Coleman[1] in 1927 failed to germinate the spores, and believed that the failure might be due to chitinous endospore. Bose[2] in 1929 successfully germinated the spores in malt-extract agar medium (3 per cent. malt-extract, 2 per cent. agar and 100 c.c. dist. water, pH 6·9). Venkatarayan[3] subsequently in 1936 failed to germinate the spores, though he tried a number of media.

It is now found that spores germinate easily in 3 per cent. and 2 per cent. malt-extract agar medium. For this purpose sporophores were collected from Calcutta on 16th September, 7th October and 21st November 1942. The sporophore was separated from the substratum carefully without touching the hymenial surface, and was kept as a whole without sectioning, above the agar-floor of a sterilised agar plate by means of three glass rings. A number of mature brown spores was thrown on the next day in each case. The spore fall continued for two days. The spores were aseptically transferred to malt-extract agar tubes (2 per cent. malt-extract, 2·5 per cent. agar and 100 c.c. dist. water, pH 6·8), where they are growing normally; the hyphæ are hyaline, branched and septed, the septa showing a good number of clamp-connections. During this period the room-temperature varied from 32° to 20° C. and the relative humidity, from 98 to 52 per cent.

It was found that in laboratory conditions the sporophores discharged spores for 1 to 2 days only. Field observations for a number of years indicate that in *Ganoderma lucidum* the spore fall is usualy abundant when the colour of the hymenial surface is grey and moist, the spore fall becomes less when the colour is changed to white and it usually stops when the colour turns brownish. In a private communication to Dr. S. R. Bose dated 30th May 1932, E. J. H. Corner of the Singapur

Botanic Garden wrote that *Ganoderma* sporophores throw out spores only when they are well-grown with their tubes 1 cm. or more long. But in these specimens of *G. lucidium* the sporophores had tubes only 2-3 mm. long.

This work was carried out by me as Kirtikar Research scholar of the Calcutta University in the Botanical Laboratory of the Carmichael Medical College, under the direction of Dr. S. R. Bose, Professor of Botany.

Calcutta,
December 18, 1942. SUBODH KUMAR SENGUPTA.

1. Coleman, L. C., "Structure of spore wall in *Ganoderma*," *Bot. Gaz.*, 1927, **83**, 48-60. 2. Bose, S. R., "Artificial culture of *Ganoderma lucidus* (Leyss.) from spore to spore," *Ibid.*, 1929, **87**, 665-67. 3. Venkatarayan, S. V., "The Biology of *Ganoderma lucidum* on Areca cocoanut palms," *Phytopathology*, 1936, **26**, 153-175.

A NOTE ON THE NESTING HABITS OF THE OLIVE LOGGER-HEAD TURTLE, *LEPIDOCHELYS OLIVACEA* (ESCHSCHOLTZ) AT KRUSADAI ISLAND*

THREE species of turtles, namely, the Green Turtle *Chelonia mydas* (Linne), the Olive Logger-head Turtle *Lepidochelys olivacea* (Eschscholtz) and the Hawksbill Turtle *Eretmochelys imbricata* (Linne) occur in the sea around Krusadai Island. The edible Green Turtle is common but curiously enough it does not nest on the Island. The Hawksbill Turtle is very rare in its occurrence. The Olive Logger-head Turtle is just as common as the Green Turtle. There is a fishery of the Logger-head Turtle in the coastal villages of the Gulf of Manaar.

Nesting: That of the Logger-head Turtle alone on the sandy coast of Krusadai Island

Date	Phases of the Moon	Date on which nests were located	Number of nests
20-10-41	New Moon	18-10-41	1
4-11-41	Full Moon	2-11-41 & 7-11-41	2
19-11-41	New Moon	17-11-41	1
3-12-41	Full Moon	3-12-41	1
18-12-41	New Moon	16-12-41 & 21-12-41	3
2- 1-42	Full Moon	30-12-41, 2- 1-42 & 4- 1-42	3
16- 1-42	New Moon	16- 1-42	1
1- 2-42	Full Moon	1- 1-42	2
15- 2-42	New Moon	17- 2-42	1
3- 3-42	Full Moon	5- 3-42	1
16- 3-42	New Moon	—	—
1- 4-42	Full Moon	1- 4-42	1
15- 4-42	New Moon	18- 4-42	1
		Total number of nests	18

came under my observation. Altogether eighteen nests were examined. There seems to be a lunar periodicity in the act of oviposition as will be evident from the above table.

The nest is but a simple burrow dug out in the sand above and away from the high water-mark. The distance between the high water-mark and the burrow varies from 6 to 30 feet. The burrow is about 1½ ft. wide at the bottom and 1 ft. wide at the top and 2 ft. deep. The long axis of the burrow forms an acute angle with the surface-level axis of the ground and its blind pocket is turned away from the sea. Thanks to the maternal instinct of the mother-turtle to hide all traces of the packing of her eggs in the burrow, she bites off pieces of plants found in the neighbourhood, such as Ravana's moustache, *Spinifex squarrosus*, the herb, *Launea pinnatifida* and the Ground-Glory, *Ipomea biloba* which grow wild in the Island, and covers the top of the burrow.* For one or two days immediately after nesting, the nest can be easily spotted by the trail of the mother-turtle and the damp soil of the now closed external orifice of the burrow. The nesting season commences in October of one year and ends in April of the following year—*vide* table.

Eggs: The number of eggs in a nest ranges from 90 to 125. The eggs are spherical and their diameter varies from 36 to 39 mm. The shell is leathery. The eggs are packed in the blind pocket of the burrow to a height of 1 ft.

Incubation: Eggs removed from the nests and buried in pits 1½ ft. to 2 ft. deep, dug near the Laboratory, hatch. The period of incubation is from 54 to 56 days. The embryos after hatching out remain in the nest from 4 to 6 days. Subsequent daily observations revealed that the hatched young ones worked their way upwards to the surface at the rate of 2 to 3 inches a day. Finally they reach the surface on the 4th, 5th or 6th day after hatching, and toddle towards the sea, on entering which they paddle away unaided. The axis of exit follows the slanting long axis of the burrow scooped out by the mother-turtle as well as the vertical long axis of the pit dug artificially, thus indicating that the young ones are guided only by the looseness of the sand packed.

Economic Aspect: Turtle-nest hunting is seldom practised and consequently, the percentage of young ones added annually to the existing stock of Logger-head Turtle population must be considerable. This perhaps partly explains the abundance of this turtle in the sea of Krusadai. In Ceylon, the eggs of this turtle are sold in fish-markets, whereas in the maritime villages near Krusadai, they are only occasionally eaten by turtle catchers and, therefore, do not extend into general consumption, another factor which doubtless contributes to

* Published with the permission of the Director of Industries and Commerce, Madras.

* Deraniyagala who has observed the nesting habits of the same turtle in Ceylon does not record this detail. For other differences between his description and mine, the reader may refer to pp. 154–55 of "The Tetrapod Reptiles of Ceylon," Vol. I, by P. E. P. Deraniyagala.

their abundance in the seas around Krusadai. Crude oil is extracted by fishermen from the flesh of this turtle and is used by them for smearing country-crafts. The determination of the nesting season and a study of its nesting habits have, therefore, a bearing on the protection of this turtle-fishery, should such a need arise in the future.

Krusadai Biological Station,
Pamban P.O., P. I. Chacko.
December 9, 1942.

ON THE MANUFACTURE OF GLANDULAR PRODUCTS IN INDIA

The recent note[1] by Prof. Dey on the preparation of adrenalin from suprarenal glands is of interest to those who are associated with the manufacture of adrenalin hydrochloride solution in India. In a previous note[2] it was recorded that the total amount of adrenalin that might be produced from natural resources would barely exceed 100 ounces; whereas Dr. Dey now on the authority of the Board of Scientific and Industrial Research mentions that the mobilisation of the raw materials from the slaughter houses of only ten of our large cities might lead to the production of sufficient adrenalin to meet the demands of civilian population and the military requirements. But Prof. Dey has not pointed out his method of extraction, nor the exact yield of adrenalin per 100 glands as collected from the local slaughter houses. In handling thousands of glands we are finding that the average weight of a suprarenal gland comes to about 4·8 to 5·0 gm., and the yield of pure adrenalin per 100 of such glands varies from 0·1 to 0·12 gm. This figure is about 25 per cent. lower than what is being recorded in some standard books[4] where the yield is shown to be 0·13 to 0·16 gm. per 100 glands. Of course it is not known to us whether this low yield is due to any defect in our technique of extraction, collection of glands or to some inherent drawback in the nature of glands themselves.

It must, however, be noted as already recorded by Dey[3] that adrenalin being a hormone of emergency may be excreted out into the circulatory system of the animals when they are brought to the abattoirs as existing in the present state. In connection with our work on the posterior pituitary lobes we also find that although the powder that is finally obtained by drying the fresh lobes collected from the local slaughter house possesses the same potency as what is being noted in a similar powder secured from reputed firms in the Western countries, the yield in dry powder is again about 40 per cent. less than that recorded by workers abroad. Thus, in isolating the physiological principles whether from suprarenals, gall bladders, pituitary lobes, or any other gland, the purity of the product is beyond question, but the yield on the amount of the active principle is invariably poor. The problem is how to increase this yield. The method of slaughtering is to be altered and the abattoirs are to be improved. The solution, however, seems mainly to remain in melioration of the breed and class of animals that are being daily brought down to the slaughter houses for supplying the meat requirements of the cities.

Bengal Immunity Research
Laboratory, Calcutta. U. P. Basu.
January 15, 1943.

1. This Journal, 1942, **11**, 444. 2. *Ibid.*, p. 290. 3. *Ibid.*, p. 420. 4. *Cf.*, Fourneau, *Organic Medicaments and Their Preparations* (J. & A. Churchill), 1925, p. 230.

I have read with much interest the note sent by Dr. Basu on the manufacture of glandular products in India. Full details of experiments regarding methods of extraction, and exact figures relating to yields of products at different stages, could not be disclosed in the publications which have appeared from time to time from this laboratory, as the investigations were being carried out under the auspices of the Board of Scientific and Industrial Research who possessed all the rights over the results. The publications were intended principally to focus attention on what seemed to be a topic of great public interest, and I am glad to note that this purpose is being achieved to a great extent.

Without any fear of infringing on the rights of the Board, it may be stated definitely that the yields of adrenaline obtained in this laboratory, have been considerably higher than those reported by the writer. An important reference appears also to have been misquoted: The yield obtained by Fourneau is 0·13 to 0·16 gm. per 100 grams of gland material and not per 100 glands. The weights too of the glands mentioned—4·8 to 5 gm.—make it obvious that only glands of cattle are referred to; the glands of sheep have been left out of the calculation. Several thousands of these animals, however, are being slaughtered daily in our cities, and although the sheep glands are much smaller than those of cattle, they must, by sheer weight of numbers, inevitably constitute the major bulk of the raw material for these products.

The statement that the yield of active principles from the glands of Indian animals is invariably poor is also not always borne out by experience. In the brief review of the technical work of the Board of Scientific and Industrial Research, published in your *Journal* (1942, p. 171), it was pointed out that desiccated Thyroid, as prepared in Madras, is considerably richer in Thyroxin-Iodine than the specimens imported from abroad. In the case also of the Pituitary, although the net weight of the whole gland is smaller, there is a special feature of the Indian animal gland which has been found to make up to some extent for its deficiency in weight.

I may take this opportunity to point out that further statistics, which have now been made available by the Board, confirm our original belief that, as in the case of adrenaline so also in the case of posterior pituitary extracts, India could supply all her requirements.

Presidency College,
Madras, B. B. Dey.
February 4, 1943.

REVIEWS

A New Physical Chemistry*

Physical Chemistry may be defined as a consideration and interpretation of the facts of chemistry in the light of physical principles. An exposition of the relevant physical principles followed by an application of the same to specific chemical themes should accordingly form the plan of any rational treatise on the subject. The kinetic theory of gases and the principles of thermodynamics formed the common ground between physics and chemistry till some two or three decades ago. The remarkable developments which have taken place of recent years in atomic physics have, however, tended to bring physics and chemistry into much closer union at the present time. We may specially mention here the interpretation of atomic structure on the basis of the spectroscopic evidence, the elucidation of molecular structure by studies on band-spectra, infra-red absorption and light scattering, and the analysis of crystal structure by studies on X-ray and electron diffraction. The development of the new quantum mechanics has also made possible an understanding of the nature of the atomic forces operative in chemical reactions. We have not yet reached the stage when theoretical chemistry may be described as a branch of mathematical physics, but we are certainly tending in that direction. It is, therefore, only appropriate that the coming generation of physical chemists should realise the situation and make themselves familiar with the newer physical ideas and mathematical methods before they become "too old to learn". Only thus can they hope to really understand their subject or to make any contributions to it.

The treatise under review will undoubtedly assist in giving the new orientation desired for the teaching of physical chemistry to the rising generation. It may be a shock to the orthodox physical chemist to find a treatise on his subject which leaves out the theory of solutions, ignores colloid chemistry and even makes no mention of the phase-rule. But such omissions could scarcely be avoided if room were to be found for developing the foundations on which could be based a rational treatment of chemical thermo-dynamics, chemical equilibria and chemical kinetics.

As remarked by the author in his Preface, "the book is complete in itself; it does not expect of the student that he shall have at his elbow a number of other books. All theorems are derived; no proof is taken for granted". These are valuable features which will be greatly appreciated by teacher and student alike.

The book is very heartily commended.

C. V. RAMAN.

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* *Physical Chemistry—An Introduction*. By Dr. E. A. Moelwin-Hughes. (Cambridge University Press), 1940. Pp. viii + 660. Price 45*sh*.

Advances in Enzymology, Vol. I. Edited by F. F. Nord and C. H. Werkman. (Interscience Publishers, Inc., New York), 1941. Pp. x + 433. Price $5.50.

Early in 1939, it was learnt that Professor Nord chose to leave his country and that the University of Fordham had extended its hospitality to the illustrious founder and editor of *Ergebnisse der Enzymforschung*. His friends the world over were expecting that he would organise the publication of another series.

The present volume marks the commencement of the expected series and is intended to be of "service to those investigators who are devoting their efforts to extending our knowledge" in the field of enzymes and related subjects. The scope of this series is sufficiently broadbased to include critical reviews on proteins, viruses, photosynthesis and differs in this respect from the series, the *Ergebnisse der Enzymforschung* whose eighth, and we believe, the last volume, was published early in 1939; the series has apparently suspended its publication, presumably on account of the distractions and privations incidental to modern wars which render the peaceful pursuit of fundamental research difficult if not impossible.

The volume consists of ten contributions; the appropriateness of prefacing the series with a provocative review on protein structure is realised if attention is called to the impressive assemblage of "active proteins" which have been isolated during the last decade in a state of integral purity and crystallinity. Although the nature of the prosthetic group of several of the dehydrogenases, has been largely elucidated, practically nothing is known about the corresponding apodehydrogenase and the virus proteins. The next phase of development in the field of oxidation and reduction enzymes and viruses will lie in the elucidation of the nature of the active groups characterising these "active" proteins. Bull's discussion on protein structure which draws pointed attention to the several shortcomings in the present theory of protein structure, is most opportune; it will serve to focus attention on the several obscure points and stimulate further work in this important field.

The second contribution by Holzapfel relates to a consideration of the physicochemical behaviour of plant viruses in relation to their activity. Bergman and Fruton have discussed the specificity of protinases, a subject to which they have made fundamental contributions. The phosphorylations which precede the stepwise fission of carbohydrates, the intermolecular transfer of hydrogen and the transportation of entire groups or radicles from one molecule to another, are all coupled with the energy changes associated with the phosphate bond. In an informative article on the metabolic generation and utilisation of phosphate bond energy, Lipmann has surveyed the subject of the energetics of cell metabolism in relation to the rọle played by

phosphorus. The chemical nature of catalase has been reviewed by Summer and the functional character of the low molecular weight prosthetic groups—coenzymes which include vitamins, heavy metals, etc., is discussed by Green whose share in the development of this field has been large and spectacular. Other contributions include reviews on photosynthesis, Bacterial photosynthesis, Enzymatic processes in living plants and the Digestion in lower vertebrates. It will thus be seen that the volume covers a wide and comprehensive field of Enzymology and related subjects. Scientific workers will feel particularly grateful to Professor Nord and his collaborators for inaugurating this series and we wish to take this opportunity of wishing their venture an uninterrupted career of service in promoting the advancement of Enzymology.

Modern Pottery Manufacture. By H. N. Bose. (Ceramic Publishing House, 1, Church Road, Bhagalpur), 1942. Pp. vi + 481. Price Rs. 6-8-0.

This book has been written mainly as a text-book for undergraduate students of ceramics in India, but it will also be found useful to many practical workers in the field, particularly for the assortment of practical formulas using Indian raw materials which have been tried out by the author in the laboratories and ceramic plants of the Benares Hindu University. Considered purely from the didactic point of view, there is scope for improvement in the presentation: expressions such as "graphite is a peculiar form of carbon" on page 320, and elementary portions such as the "mathematical calculations" on page 437, can be eliminated, and some of the diagrams such as Figs. 6, 23, 25 and 51 can be corrected and improved. An index will add considerably to the value of the book as a reference volume, particularly as it embraces all the different branches of the subject such as porcelain, stoneware, refractories, fuels, furnace and kilns, in one handy volume. We do hope that in the future editions to come, this essentially practical volume will grow to a higher standard of usefulness to all ceramists in India.

The book is rightly dedicated to "Reverend Pandit Madan Mohan Malaviya, the great Indian Educationist, who had the keen insight to recognise the importance of Ceramics to India, and first started the scientific training in the subject in the Benares Hindu University.

S. J.

Pheretima (An Indian Earthworm). By Karm Narayan Bahl. (*The Indian Zoological Memoirs*, Lucknow), January 1943. Price Rs. 1-12-0.

The series of Zoological monographs entitled "Indian Zoological Memoirs" is so well known to all zoologists in this country that it should not need any further introduction for the readers of *Current Science*. It may, however, be noted that the series was started in 1926 under the editorship of Dr. Karm Narayan Bahl, Professor of Zoology, Lucknow University, and eight memoirs have already been published The memoir under review is the third edition of the first memoir of the series, the editor's *opus magnum*, on *Pheretima* (an Indian earthworm). The first edition was published in 1926, the second in 1936, while a new and entirely revised edition has been issued in January 1943. The usefulness of the work can be gauged from the fact that within less than two decades two new editions have been issued.

The work, as it stands, is probably the most complete account available of any of the commoner Invertebrates of India. The author has spared no pains in bringing the text up-to-date by incorporating the results of all recent work, by thoroughly revising the descriptive account, and by the incorporation of additional illustrations. He has also indicated where our knowledge about this worm is deficient and where further research is desirable. The memoir is excellently printed and is remarkably free from misprints. The author deserves the best thanks of the zoologists in India for this excellent memoir, and it is hoped that further volumes in the series will be published as and when ready so as to provide students of Indian Zoology with authoritative accounts of various Indian types.

B. P.

INDIAN STATISTICAL CONFERENCE

A LAST minute change in the venue of the Conference, the inability of the Governor of the Province to open the Session in person and with customary ceremony, a demonstration at the gates timed to synchronise with the arrival of the Vice-Chancellor of the University and the Chairman of the Reception Committee, and above all, the threat of air raids and the sight of enemy aircraft actually brought down in wreck and fire in the area, are not occurrences expected by any known statistical law or hypothesis and yet the goodness of fit between the Sixth Session of the Indian Statistical Conference at Calcutta in January last and the previous five annual meetings is both high and helpful. There was a Message from His Excellency the Governor which reminded that when peace comes, when commerce, future of industry and of the economic life of the peoples have to be planned, it is statistical science that would largely help in fashioning them. The Hon'ble Mr. N. R. Sarkar stressed the same thought in his presidential address. "It is well nigh impossible", said the President who is also the Commerce Member in the Viceroy's Executive Council, "to prosecute a totalitarian war without the aid of the statistician at every turn. Problems of price control, rationing, production and distribution of food and clothing, maintenance of real wages and regulation of dearness allowance, all these required careful collection of data and the scientific study of relevant statistics."

The stage thus set was a valuable lead to the scientific meetings of the Conference. In

the discussion on Applied Statistics, Professor Benoy Kumar Sircar explained the use of statistics in economic planning with special reference to Russia. Census figures of Bengal, enquiry on behalf of "Capital" into the budgets of Anglo-Indian and European families in Calcutta, the Labour Office inquiries in Nagpur, the defects of Laspeyer Index and the method of sample surveys were brought into the scope of the discussions. In the course of the development of each bit of scientific knowledge there comes a time when the experimental technique must be questioned. Are they adequate to furnish the demanded precision of results? Is the most helpful point of attack in the laboratory methods or in the experimental material? Fortunately statistical methods supply answers in many cases with little or no extra labour in collecting data, provided only that slight but necessary modification be included in the plan of the experiment. This possibility has been brought to the foreground in a very clear manner in the analysis of agricultural statistics, and quite naturally that subject claimed a session for itself in the discussions. The Chairman, Mr. R. C. Bose, drew attention to the use of Finite Geometries in furnishing completely general solutions for all problems concerning Symmetrical Factorial Designs. The scope of the teaching of Statistics in Indian Universities, with equal emphasis on analytical and descriptive statistics, elicited good discussion in which Prof. F. W. Levi, Prof. P. C. Mahalanobis, and Mr. Tu Yun Sun of the National Tsing Hua University, took part. Earlier in the day, Dr. B. C. Roy, as Chairman of the Reception Committee, had narrated the measures taken in that direction by the Calcutta University.

No account of the Statistical Conference can be complete without reference to the work of the Calcutta Statistical Laboratory and to the journal *Sankhya*, both of which, as His Excellency rightly acclaimed, are "monuments to the foresight and indefatigable labours of Professor Mahalanobis to whose devoted enthusiasm for statistics India is deeply indebted". The Statistical Laboratory has undertaken with great success a large number of inquiries on behalf of the Government of India as well as Provincial Governments and of States such as the production of important food crops like paddy and wheat, cash crops like jute and sugarcane. It has investigated problems of flood control and irrigation, anti-malaria measures, nutritional programmes, cinchona production, average lifetime of rupee notes in circulation and so on. The list of papers published and reports submitted during 1942 includes no fewer than thirty titles from ten different authors. The financial condition of such an Institute must undoubtedly be above anxiety, but in the words of the Honorary Secretary, "this year, for example, no less than two lakhs of rupees will have been spent, but in three months' time our income may literally drop to zero because we have no permanent grants or endowments. Though this very insecurity has developed our self-confidence, there is a point beyond which such insecurity begins to exert a harmful influence". It is to be hoped that the contingency last indicated may never arise.

K. B. M.

CENTENARIES

Banks, Joseph (1743–1820)

JOSEPH BANKS, British botanist and pioneer explorer, was born in London, 13 February 1743. He was immoderately playful till his fourteenth year when he suddenly became a botanist in a burst of schoolboy enthusiasm. One fine summer evening he had stayed bathing in the Thames so long, that he found that all his companions had gone. Walking back leisurely along a lane, he was struck by the beauty of the flowers on either side. He immediately decided to learn botany. He learned from a woman employed in collecting herbs for a druggist's shop paying her six pence per lesson. When he went home for the next holidays, he picked up Gerard's *Herball* in his mother's dressing room. This not only described his plants but also contained engravings of them. When he went to Oxford in 1760, botany was not taught there. But his enthusiasm for the subject made him go to Cambridge and bring a private tutor.

His father's death brought him an ample fortune and an estate. He, therefore, left Oxford in 1763. But his superior attainments in natural history secured for him Fellowship of the Royal Society as early as 1766.

The epic days of scientific exploration began with Banks, who obtained permission to accompany Captain Cook in his *Endeavour* taking his own technical staff with him. The *Journal* which he kept was utilised in the relation of that famous voyage round the world (1768–1771). It was admirably kept and he never let a day pass without an observation. After changing several hands the *Journal* was finally deposited in the British Museum and was not printed till Hooker edited and published it in 1896.

Banks was elected President of the Royal Society in 1778 and his drive caused quite a stir in the Society and in spite of much revolt from some he kept that position till his death. Though his writings were very few and some of them still remain as manuscripts in the British Museum, he employed himself with extraordinary zeal and industry to collecting and observing. His contribution to the growth of science was even greater as a munificent and influential patron. His vast collections and his library, the biggest of its kind in the country, were freely accessible to all scientific men and his house in Soho Square was the focus of science. His library is still preserved by itself in a room of the British Museum and his collections, at South Kensington.

He was scientific adviser to George III,

whom he persuaded to purchase a house in 1818 to provide a Herbarium and a Library for the Kew Gardens. The use of the house was, however, delayed by the death of both. George IV sold it to the nation in 1824 for £84,000 to clear his debts. William IV gave it away to the Duchess of Cumberland. It was not till 1837 that Victoria lent it to the Gardens and it was not discovered till 1876 that it had been already purchased from George IV.

Banks was fair to the core in his attitude towards foreign naturalists. Sometimes it was even proved embarrassing. For example, when the collections made by La Billardiere fell by fortune of war into the British hands, Banks managed to have them handed back to France, saying that he would not steal a single botanic idea from those who had gone in peril of their lives to get them. Ten times were parcels addressed to the Royal Garden at Paris, captured by English cruisers and each time they were returned.

Banks died at Spring Grove, 19 June 1820.

Seed, Miles Ainscough (1843—1913)

MILES AINSCOUGH SEED, the inventor of the dry plate, was born in Preston, 24 February 1843. He became vitally interested in photography, then in its infancy and began experimenting with different processes for making and developing photographic plates. Finding the conditions in his native land unfavourable, he migrated to the United States in 1865. After several years of persistent effort, he succeeded in hitting upon the idea of the dry plate and established in 1882 the M. A. Seed Dry Plate Co., in St. Louis. By reason of his tenacity and personal visits and propaganda he overcame the prejudice of photographers against his new invention. Eventually it turned out that his dry plate was the first one sensitive enough to be used for X-ray purposes and for astronomical photography.

Seed died at Pelham, 4 December 1913.

Madras University Library,
February 4, 1943. S. R. RANGANATHAN.

SCIENCE NOTES AND NEWS

Germination of Ergot.—In his letter dated December 16, 1942, Mr. A. B. Bose, Botany Laboratory, Carmichael Medical College, Calcutta, writes:—"It has been brought to my notice by Prof. H. P. Chaudhuri of the Punjab University, that after the publication of Dr. Pushkar Nath's note in *Current Science* (1941, p. 488), Prof. Chaudhuri got a new collection from Simla and it was from this collection that he kindly sent me some material. The material was not, therefore, obtained from Dr. Pushkar Nath as stated by me previously (*Curr. Sci.*, 1942, p. 439) due to misapprehension."

Manufacture of Newsprint, Cheap Papers and Boards in India.—The possibility of utilising indigenous raw materials for the manufacture of cheap newsprint has received attention from a long time past. But, till recently the Indian demand for newsprint was so limited that it was hardly economic to put up a plant even if other conditions permitted such a step. But this market has steadily expanded and quite apart from this, war conditions have compelled a thorough review of the feasibility of Indian manufacture of these imported commodities. Such a review is contained in an interim report by Messrs. M. P. Bhargava and S. Kartar Singh (*Indian Forest Bulletin*, No. 108, 1942. Price As. 9 or 10*d*.) whose conclusions are not very encouraging. After experimenting with various Indian species, three of conifers, seven of broad-leaved species and three bamboos, these authors find fir and spruce (available in fair quantities in certain parts of India), quite suitable for newsprint production while three of the broad-leaved species were considered promising. Unfortunately, however, the two conifers abound in areas where cheap power is not available so that the prospects for a thriving Indian newsprint industry are none too favourable just at present. The bulletin contains sixteen samples of paper with their composition of mechanical pulp and chemical pulp indicated. The sober conclusions recorded in this bulletin should be helpful in dispelling facile optimism about ambitious but ill-conceived schemes for newsprint production in the country.

Factors Governing the Adhesion of Tin-Base Bearing Metals.—The Tin Research Institute's publication No. III records a comprehensive study of the factors governing the adhesion of tin-base bearing alloys to various backing metals, including steel, bronze, copper, brass and cast iron, by W. T. Pell-Walpole, J. C. Prytherch, and B. Chalmers. The conditions for obtaining efficient bonds are considered, and the many factors affecting these conditions in manufacturing operations are examined. A large number of tests are described which indicate the most suitable methods of preparing and tinning the bearing shell, and of casting and cooling the lining. The results of thousands of individual tests show the effects of variations in alloy composition, mould design, temperature of metal and mould, and rate and direction of cooling, in relation to both hand-pouring and die-casting and also to centrifugal methods of production. The part played by shrinkage cavities at or near the bond is also examined, and methods of operation are suggested by which this trouble may be avoided. Copies of this paper may be obtained free of charge from the Tin Research Institute, Fraser Road, Greenford, Middlesex.

Plywood Tyres. — According to *Indian Forester*, a note in *Timber Trade Journal* of July 1942 mentions a plywood tyre taking the

place of solid rubber tyres and of trials having been very successful. Three rings of 1¾" plywood were fastened together and put on the rear wheel. The wear was slight and even, and traction on wet boards better than with rubber tyres and on dry boards about equal with the rubber variety. It is reported that drivers cannot tell the difference in driving the vehicle with the odd tyre on one wheel.

Chemotherapy and Tuberculosis.—It is possible that the long-wished-for remedy for tuberculosis may eventually come through chemotherapy. Recently, 'Promin', the didextrose sulphonate of diaminodiphenyl sulphone, a member of the suplhonamide group, has been found by Feldman and Hinshaw at Rochester, U.S.A., to be active against the tubercle bacillus both *in vitro* and *in vivo*. Prof. W. H. Tytler, of the Welsh National School of Medicine, Cardiff, has made some experimental studies with 'Promin' (*Thirtieth Annual Report* for the year ended 31st March 1942, of the King Edward VII Welsh National Memorial Association. *Report of the Director of Research*, p. 46). His results so far show that it is the most effective chemotherapeutic agent for the tuberculous guinea-pig yet tested. Unfortunately, the toxicity of the drug in the high continued dosage necessary has hitherto prevented its full therapeutic application to human beings, although in local application to superficial tuberculous lesions it is efficacious. This objection may eventually be overcome, possibly by combining the administration of the drug with that of an antigenic serum or by other modifications of its toxic properties. At all events the discovery of this drug represents an important advance and may be the prelude to greater things.—*Nature* (1942, **150**, 517).

Laxminarayan Institute of Technology, Nagpur.—In the presence of a distinguished gathering, His Excellency Sir Henry Twynam, Governor of the Central Provinces and Berar, opened the Laxminarayan Institute of Technology, Nagpur, on January 9. The Governor also unveiled a bronze statue of the late Rao Bahadur D. Laxminarayan, who bequeathed his whole estate worth about Rs. 35,00,000 for the study of applied science and chemistry in the Nagpur University. Mrs. D. Laxminarayan was present.

Requesting His Excellency to perform the opening ceremony of the Institute, Lt.-Col. T. J. Kedar, Vice-Chancellor, said that they all realised that for a Province like theirs, rich in its raw materials like oil seeds, manganese and untapped forest produce, the starting of a Technical Institute was a step in the right direction. "We have also taken care to see that training given to the students is not merely of an academic nature without any idea of actual industrial requirements, by having amongst the staff men who have had several years' experience of erection and working of factories in India, all of which augurs well for the future".

Declaring the Institute open, Sir Henry Twynam observed that at long last, the dream of the princely donor of teaching applied chemistry to the students of the Province had been realised and complimented Lt.-Col. T. J. Kedar, Vice-Chancellor, for the manner in which he successfully overcame the various obstacles in the way of establishing the Institute. He also paid a warm tribute to the munificence of the late Rao Bahadur. His Excellency regretted that the Hon'ble Mr. N. R. Sarker, Commerce Member of the Government of India, could not be amongst them to deliver the inaugural address on the occasion. The inaugural address of the Hon'ble Mr. Sarker was read in his absence by Major N. Ganguli. A. N. K.

Indian Central Jute Committee.—Mr. I. G. Kennedy was elected Vice-President of the Indian Central Jute Committee for 1943-44 at its meeting held to-day under the presidency of Mr. P. M. Kharegat, C.I.E., I.C.S., President of the Committee and Vice-Chairman of the Imperial Council of Agricultural Research.

The proceedings opened with a short speech by the President condoling, on behalf of the Committee, the death of Sir Bryce Burt, the first President of the Committee, recently in England, and offering felicitations to Lala Padampet Singhania on the recent conferment of Knighthood and to Mr. H. M. Jhunjhunwalla on the conferment of the title of Rai Saheb, both members of the Committee.

Vacancies having arisen in the Standing Technical Sub-Committees due to the expiry of the terms of certain members, in addition to the sitting members, the following were appointed to the Sub-Committees noted against their names:—

Local Sub-Committee: Mr. S. N. Biswas, Mr. M. A. H. Ispahani and Mr. M. P. Birla; *Agricultural Research Sub-Committee*: Mr. A. M. A. Zaman, Mr. A. L. Mondal and Mr. S. N. Biswas; *Technological Research Sub-Committee*: Mr. M. A. H. Ispahani, Mr. M. P. Birla and Mr. C. L. Bajoria; *Marketing Sub-Committee*: Mr. A. L. Mondal, Mr. S. N. Biswas and Mr. A. M. A. Zaman; *Economic Research and Publicity Sub-Committee*: Mr. M. A. H. Ispahani, Mr. M. P. Birla and Mr. S. N. Biswas.

Textile Essay Competitions: Award of Prizes and Medals.—These competitions are open to all from all parts of India, and no entry fee will be charged. The competitors need not be members of the Textile Association. [Members of the Managing Committee of the Textile Association (*India*) are not eligible.]

There will be five separate competitions as follows: (1) Improvements in Textile Machinery—Original. (2) Improvements in Textile Manufacturing Technique—Original. (3) Latest Developments in Textile Machinery or Processes—Survey or Original. (4) Labour and Welfare, pertaining to Textile Industries. (5) Indian Textile Fibres, their Production and Utilization.

A competitor may, if he so desires, submit papers on more subjects than one. Each paper shall be treated alternatively; but a competitor will not be eligible to receive more than one prize.

All papers shall be in English. The length of the paper shall not exceed fifteen foolscap size sheets (30-32 lines to a sheet) with a margin of about two inches, typed on one side only. Inclusion of illustrations, graphs or tables, hand-drawn, is permitted.

The paper must be enclosed in a sealed cover, on which the competitor should write particulars as under:—

Prize Competition Paper, *Nom-de-plume*, Subject or Subjects.

Subjects requiring originality must be original and vouchsafed as such. Reference from other papers is allowed if duly acknowledged with such details as (1) Name of source, (2) Date of publication, (3) Name of author, (4) Page and (5) Year.

The competitor's name should not appear anywhere, in the paper or on the envelope in which the paper is enclosed. In another sealed cover of a smaller size with details as above, the competitor should enclose a separate paper giving the following particulars:—

Full Name, Postal Address, Name of Employer if employed, and capacity in which employed, Age, Technical Qualification if any, and duration of practical experience in Textile line.

On the outside of the small cover, the competitor should write his *Nom-de-jlume* only.

Both the sealed covers should be enclosed in a large cover and delivered to the Hon. Secretary of the Association, in person, per bearer or through post, under a registered cover, so as to reach him on or before the end of 30th April 1943. Unstamped or insufficiently stamped envelopes are liable to be returned.

The judges of the competitions will be appointed as follows:—

Two independent persons of position from the public and one nominated by the donor, for each of the five competitions.

Majority opinion of the judges will be final as regards the prize in each subject. The final declaration of the prizes will be made by the Managing Committee of the Textile Association (*India*).

Prizes will be awarded as follows: (1) Improvements in Textile Machinery—*The Textile Association* (India) *Gold Medal* of the value of Rs. 150. (2) Improvements in Textile Manufacturing Technique—*The Delhi Cloth Mills' Prize* of the value of Rs. 200. (3) Latest Developments in Textile Machinery or Processes—*The Khatau Gold Medal* of the value of Rs. 100 and Rs. 201 cash prize to the same person. (4) Labour and Welfare pertaining to Textile Industries—*'The Indian Textile Journal' Prize* of the value of Rs. 150. (5) Indian Textile Fibres, Their Production and Utilization—*E. D. Sassoon Mills' Prize* of the value of Rs. 300.

The result of these competitions will be declared by the 15th June 1943, or earlier if possible.

If, in the opinion of the Examiners, a competitor's essay falls below the standard expected, in such a competition, they may not award any Prize and|or Medal to him, even though it may be the best amongst the essays submitted on that subject. The Examiners may, at their absolute discretion, recommend to the Managing Committee, the award of a prize of smaller value in such a case.

The award of Prizes or Medals will be confirmed by Certificate of Merit issued by the Textile Association (*India*).

The closing date of the Competition is 30th April 1943.

Further particulars may be had from:—Narain V. Ullal, Hon. Secretary, The Textile Association (*India*), "Ganesh Bhavan," Parel P.O., Bombay.

Archives of Biochemistry, a new journal on biochemistry, has been announced by the publishers; The Academic Press, Inc., 125 East, 23rd Street, New York City. The first issue will appear about the middle of October. The purpose of the new journal is to provide a medium of publication for scientific papers in the widening scope of biochemistry. The fields to be represented are: Proteins, hormones, vitamins, viruses, enzymology, biochemical and biophysical research in chromosomes, metabolism, nutrition, photosynthesis, plant chemistry, organic chemistry as far as related to living organisms, colloid science in its biological applications and chemotherapy. The Editorial Board is composed of Professors M. L. Crossley, American Cyanamid Company, Bound Brook, N.J.; R. A. Gortner, University of Minnesota; F. C. Koch, Research Department of Armour and Company, Chicago; C. M. McCay, Cornell University; F. W. Nord, Fordham University; F. W. Went, California Institute of Technology, and C. H. Werkman, Iowa State College. Manuscripts may be sent to any of the editors or to the editorial office at 125 East, 23rd Street, New York City. Two volumes per year are planned, the cost of each volume being $5.50.

—*Science*, 1942, 96, 269.

Bruhl Medal.—Rao Bahadur G. N. Rangaswami Ayyangar, B.A., F.N.I., I.A.S. (Retired), of Coimbatore, has been awarded the BRUHL MEDAL by the Royal Asiatic Society of Bengal, for his meritorious research work in Botany. Our hearty felicitations to the distinguished recipient.

Lucknow University.—The following candidates have been declared eligible to receive the degree of PH.D. in the Faculty of Science, Lucknow University:—

(1) Mr. Rajendra Varma Sitholey, M.Sc., on a thesis comprising a series of papers on "Fossil Plants from India, Ceylon and Afghan-Turkistan". (2) Miss Mary Chandy, M.A., on "The Anatomy of the Sting-Ray (*Trygon*)". (3) Mr. Bijan Bihari Lal, M.Sc., on "The Photochemical Reactions in Solution: The Photochemical After-Effect".

Mr. Vidya Bhaskar Shukla, M.Sc., has been declared eligible to receive the Ruchi Ram Sahni Research Prize in Botany on the basis of a dissertation comprising original papers on fossil plants from the Deccan Inter-trappean Series.

SEISMOLOGICAL NOTES

During the month of December 1942, ten slight and two moderate earthquake shocks were recorded by the Colaba seismographs as against one great, three moderate and three slight ones during the same month in 1941. Details for December 1942 are given in the following table:—

Date	Intensity of shock	Time of origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
		H.	M.	(Miles)		(Miles)	
3	Slight	01	05	2490	..		
4	Slight	21	55	5520	..		..
5	Slight	20	58	6420	..	..	..
10	Slight	04	49	6150	..	..	..
11	Moderate	09	09	2760	..	..	Epicentral region located in Anatolia. Several houses collapsed and many were damaged in Northern Anatolia. The shocks were especially severe in Tchorum District.
19	Slight	15	51	1270	..	..	
20	Moderate	20	33	2490	..	..	Epicentral region located in Central Anatolia. Over 1,000 persons killed and more than 3,000 wounded in the region of Tokat in Central Anatolia. One township was completely destroyed.
22	Slight	03	51	1670	..	140	..
23	Slight	11	40	1590	..	..	..
23	Slight	20	29	5530	..	..	..
27	Slight	23	10	4410	..	..	..
29	Slight	10	12	3630	..	..	..

MAGNETIC NOTES

Magnetic conditions during December 1942 were slightly more disturbed than in the previous month. There were 16 *quiet* days, 13 *slightly disturbed* days and 2 days of *moderate* disturbance during December 1942 as against 13 quiet days, 16 days of slight disturbance, 1 of moderate disturbance and 1 of great disturbance during the same month in 1941.

The quietest day during December 1942 was the 30th, while the 23rd was the day of largest disturbance.

The individual days were classified as shown below:—

Quiet days	Disturbed days	
	Slight	Moderate
1, 2, 5, 6, 13, 15–19, 25, 27–31.	3, 4, 7–12, 14, 20, 22, 24, 26.	21, 23.

No magnetic storms occurred during December 1942, while one storm of great intensity was recorded during December 1941.

The mean character figure for the month of December 1942 was 0·55 as against 0·65 for December 1941.

M. V. SIVARAMAKRISHNAN.

Dr. K. N. Menon, Professor of Chemistry, Maharaja's College, Ernakulam, writes:—"Kindly allow me to associate with the feelings you have expressed in the obituary notice (*Curr. Sci.*, 1943, p. 12) announcing the death of Richard Willstatter. It may be a very long time before we will have the opportunity to read a memorial lecture but may I be permitted to suggest to all who are interested in getting a short but lucid exposition of the contributions to the various branches of organic chemistry and biochemistry made by Willstatter and his collaborators, to read the issue of *Naturwissenschaften*, published on 12th August 1932 to commemorate Willstatter's sixtieth birthday?"

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 90, Nos. 4623 and 4625.

"Indian Journal of Agricultural Science," Vol. 12, No. 5.

"Journal of Agricultural Research," Vol. 65, Nos. 5 and 6.

"Agricultural Gazette of New South Wales," Vol. 53, Pts. 11 and 12.

"Journal of Chemical Physics," Vol. 10. No. 10.

"Indian Forester," Vol. 69, No. 2.

"Bulletin of the Indian Central Jute Committee," Vol. 50, No. 10.

"Journal of the Indian Mathematical Society," Vol. 6, No. 3.

"The Mathematics Student," Vol. 10, No. 2.

"Indian Medical Gazette," Vol. 78, No. 1.

"Review of Applied Mycology," Vol. 21, Pt. 10.

"Nature," Vol. 150, Nos. 3804, 3805, 3809 and 3810.

"Science," Vol. 96, Nos. 2491-2494.

"Sankhya," Vol. 6, Pt. 2.

"Science and Culture," Vol. 8, No. 8.

"Sky," Vol. 1, No. 12.

"Indian Trade Journal," Vol. 148, 1907-1911.

SUPPLEMENT TO CURRENT SCIENCE

Vol. XII] INDIAN SCIENCE CONGRESS, CALCUTTA, 1943 [No. 2

Summaries of Addresses of the General President and Presidents of Sections

PRESIDENTIAL ADDRESS

General President: D. N. WADIA, ESQ., M.A., B.SC., F.G.S., F.R.G.S., F.R.A.S.B.

MINERALS' SHARE IN THE WAR

IN his General Presidential Address to the Thirtieth Session of the Indian Science Congress which met in Calcutta last January, Mr. D. N. Wadia deals with the question of "Minerals' Share in the War", in the course of which he observes:

"It is no exaggeration to say that half of the later wars of history have been directly or indirectly motivated through the desire of gaining access to stores of strategic mineral products, ores, fuels, salts, alloy metals and essential industrial minerals.

"The international mineral situation during pre-war years was in a chaotic state. While the United Nations were in a state of 'vacuous unwareness' about it, the Axis powers grabbed as much of the indispensable munitions minerals as they wanted and the war has been waged by them on the stores of hoarded minerals and metals.

"Only the adoption of a wise and justly planned international mineral policy framed by an International Directorate can preserve peace and goodwill amongst countries unequally endowed by Nature with mineral wealth. No country in the world, however well-supplied it be, is self-sufficient in mineral requirements, nor is any so situated that it can regard its mineral resources as purely domestic or national. Embargoes, tariffs, patent rights and transport controls imposed for political reasons do not offer a solution, but by hindering free movement of minerals become powerful contributive factors in precipitating world wars. Unequal geographical distribution of minerals being an unalterable fact, planned international economy should devise means not only to eliminate this cause of inter-country friction but to increase the interdependence of nations on each other for their vital trades and industrial needs and so make minerals a rallying point for international co-operation and goodwill."

Talking about the Social Obligations and Relations of Science in India, Mr. Wadia writes:

"The impact of science on the Indian masses has come in the form of a rather rude intrusion of machines and mechanics into the essentially simple rural economy of the country and it is not surprising that this meeting has not been a particularly happy one. It has disturbed the economic structure and created, if not some aversion, an indifference to the cult of science in the popular mind. But we all know that science is not all mechanics nor are its practical uses to man the greatest thing about science. The greatest thing about science is the scientific method—the most effective thing man has for discovering truth and the ways of Nature. It can bring solid benefits by releasing life from stagnation and the bonds of ignorance wherever these prevail, whether in cities or in the countryside, among the labouring masses or among the governing class. The awakening to the social obligations of science is of recent date and even in Europe and America, this aspect of the cultivation of science was for long not realised and left to sporadic individual efforts. With this awakening, a twofold problem faces science all over the world to-day—to press the newest discoveries and inventions of applied science into the service of agriculture, manufactories, hospitals, homes and schools and alongside with it to so control the impact of these on his private life that his mechanised work-a-day life may not be totally divested of all higher spiritual values. Our future national life and its material well-being largely depend on a wholesome balance being maintained between these two—the impulse to harness science to increase physical comforts of life and a restraining desire to preserve the old world spiritual calm and simplicity of living."

In the concluding part of his Address, Mr. Wadia outlines a scheme for a proposed Academy of Social Science for India to promote "peace among nations and intellectual freedom in order that Science may continue to advance and spread more abundantly its benefits to all mankind". According to Mr. Wadia:

"The proposed Academy should be a body of high academic standing and professional knowledge, which can take up long-range problems of social well-being of the people of India which the older Societies and Associations established along familiar but too general lines in some cases and rather over-specialised lines in others, cannot deal with without suspicion of religious or political bias. Socio-medical and political subjects, human relations, anthropology, political science, vital statistics, social biology, population problems, sociological research in particular bearing on various Indian communities are the subjects on which such an Academy can work in collaboration with the Indian Science Congress and half a dozen other institutions already existing in the country for some of the above-named specific objects. It can be a living organ in the body politic of India for voicing the collective opinion and focussing the specialised points of view of numerous isolated working bodies on the one problem how to promote the well-being of the common man."

PHYSICS

President: Dr. H. J. Bhabha, F.R.S.

RECENT ADVANCES IN THE THEORY OF FUNDAMENTAL PARTICLES

Scientific activity began with the recording of facts of observation. This was followed by generalisations or laws based empirically on the record of such facts. Newton, by enunciating his laws of dynamics and gravitation, introduced a *new approach* to physical theory. He showed clearly that the ideas which are to be regarded as *fundamental* for the understanding of nature are certain *abstract concepts and postulates* on the basis of which certain results could be derived mathematically and compared with the facts of observation. This position was accepted because it was the only way to obtain a unified scheme for the observed regularities of nature. On the basis of such postulates, a physical theory is built up. If a newly discovered fact does not fit in with the theory, it necessitates a revision of the postulates leading to a more general theory from which the results of the older theory would follow as approximations. An example of this type of change is the theory of relativity.

The principle of relativity imposes restrictions on any physical theory that can be built up. So does the quantum theory. On the basis of the latter, Heisenberg showed that it is impossible to determine the position and momentum of a particle *simultaneously* with *unlimited accuracy*. Consequently the attempt to calculate the *exact* trajectory of a particle in space-time is abandoned. Instead, we now calculate the *probability* of a particle being in a given region of space at a given time. Consequently, the problem of mechanics at present is one of calculating a set of functions called *wave functions* from which physical properties associated with a particle can be derived. The possible wave equations from which such functions can be calculated and which satisfy the limitations imposed by the principle of relativity and the quantum theory have been given by Dirac, Pauli and Fierz. They can be shewn to describe elementary particles with integral and half integral spins. One important result of combining the relativity and quantum theories is the realisation that a one-body problem is impossible in relativistic quantum mechanics. The theory gives solutions which correspond to the particle being in states of negative kinetic energy. These solutions cannot be ruled out because transitions are possible between such negative states and positive states. Dirac overcame this difficulty by saying that all such states are normally occupied. Consequently there will be infinite and uniform distribution of charge which will produce no field. It is possible, sometimes, for a particle in a negative energy state to jump into a positive energy state. The empty negative energy state or "hole" becomes observable as a particle of the same mass but opposite charge. This corresponds to a positron in the case of the electron. The theory thus predicts the existence of the positron and the possible creation of positron-electron pairs. It is, therefore, clear that a one-body problem is impossible in relativistic quantum mechanics. These results have been verified experimentally by Anderson and by Blackett. Further developments have shewn that a physical theory of particles of half integral spin is impossible unless they satisfy the Fermi-Dirac statistics. Similarly a theory of particles with integral spin is impossible unless they satisfy the Bose-Einstein statistics.

One serious limitation of the quantum theory in its present form is that it leads to divergent results in higher approximations. This was first noticed in the interaction of electrons with radiation and it was believed that it was connected with the fact that the charge of the electron was assumed to be concentrated in a point. The work of Dirac, Pryce and Bhabha has shewn that this view is false. Dirac and Pryce have worked out a complete *classical* relativistic theory of a point electron moving in an electromagnetic field by taking into account the effects of radiation reaction on the motion of the electron exactly. Bhabha has extended the theory to spinning particles having a dipole interaction with the electromagnetic field. He has also shewn that an equally successful relativistic classical theory can be made for charged and spinning particles moving in meson fields. In all these theories, the mass of the particle is looked upon as an arbitrary mechanical constant which has nothing to do with the field the particle creates. Although the quantum theory in its present form treats the fundamental particles as points, no way of removing the infinites in an unambiguous and relativistically invariant way has been found.

GEOLOGY AND GEOGRAPHY

President: Dr. J. A. Dunn

SUGGESTIONS FOR THE FUTURE DEVELOPMENT OF INDIA'S MINERAL RESOURCES

In his Presidential Address to the Section of Geology and Geography, Dr. J. A. Dunn of the Geological Survey of India offers certain valuable suggestions for the future development of Indian mineral resources, based on his knowledge and experience during more than twenty years of scientific work done in this country continuously in connection with the mineral industry; and has specially dealt with the future actual development of the mineral resources in India. After pointing out that the two statements commonly made with regard to India's mineral position, *viz.*, (1) that India is poor in mineral resources and (2) that such mineral resources as are available here have not been developed as fully as they should have been, are both mistaken, Dr. Dunn proceeds to point out that India's mineral industry has been far from negligible and has been a valuable asset to the country. Reviewing the actual geographical distribution of minerals in the country, he shows how the different parts of India are inter-dependent and that, therefore, a co-ordinated mineral policy applied to the whole

country as a unit is desirable. Talking of the expansion of the mineral industry, he points out that this may include both the development of new mineral deposits and the creation of new industries from minerals already mined, and proceeds to discuss in detail the possible direction of expansion with reference to about forty of the more commonly occurring minerals of economic value found in India. Dealing with the several lines along which enquiries may be pursued with a view to the ultimate expansion of the mineral industry, Dr. Dunn observes: "The stimulation of prospecting must be co-ordinated with methods of prospecting, the mineral deposits must be closely studied geologically to obtain the maximum from the resources available, methods of mining must be improved, and also methods of treatment, whilst the extended use of minerals in industry must receive constant attention." In conclusion he refers to the various ways in which the State can assist the mineral industry, and points out the great and urgent need for establishing a "Minerals and Metals Research Bureau" in this country, including a "Fuel Research Station", to undertake investigations into all aspects of the mineral industry—particularly with a view to improve methods of mining, reduce cost of treatment, and further extend the application of certain minerals into fields other than those in which they are already used. From a wider point of view, it is clear that in framing a mineral policy, each country must be not merely "national" but also "inter-national" in its outlook, and we must "regard ourselves as the trustees for the world of those minerals within our territory which mankind in general needs".

BOTANY

President: Dr. K. Biswas

SYSTEMATIC AND TAXONOMICAL STUDIES ON THE FLORA OF INDIA AND BURMA

After briefly reviewing the Systematic and Taxonomical researches in India and Burma, Dr. Biswas has given a detailed exposition of the ecological and phytogeographical vegetation belts of the different regions of the country, with special reference to endemism. The origin of the flora of Tibet is discussed in a comprehensive manner. Hooker's Theory of Endemism in India, according to the author, demands considerable alteration in the light of recent systematic and taxonomical researches. It is suggested that a detailed survey of the marine flora is likely to result in reducing the food problem of the country. There is a great need for ecological work based on systematic and taxonomical studies which has a very direct bearing on many problems of practical importance. Finally a plea is made for more organised team-work in the several Universities and Institutions on the subjects of ecology and systematic botany on certain definite lines which would promote our knowledge of "The New Systematics".

ZOOLOGY AND ENTOMOLOGY

President: Dr. B. Chopra

PRAWN FISHERIES OF INDIA

Next to agriculture and perhaps animal husbandry, fishing is the biggest industry of our country. Prawns and crabs form very important part of our fisheries. The fisheries provide employment and means of sustenance to lakhs of people all over India and their total annual yield runs into enormous figures. The marine prawn of very great commercial importance in India is *Penœus carinatus* Dana which is fished extensively along the Sind and Bombay coasts, in the back-waters of Malabar and all along the Eastern coast. There are a few other species of prawns of commercial value scattered all over the country. The most important fresh-water prawn is *Palœmon carcinus* Fabr. A single specimen may weigh well over a pound.

Prawn fishing is practised on a large scale in Bengal, Orissa, Madras, Travancore, Bombay and Sind. In Travancore prawn is extensively cultivated alternately with paddy in paddy-fields. Large quantities are consumed fresh and sent inland packed between layers of ice. Prawns are also sun-dried or smoked or boiled and sun-dried. These or very similar methods are prevalent almost all over India.

Great advances in prawn industry have been made in South Africa, Norway, California and other countries. In India it is in a very backward state. At present we know very little about the habits and life-history of the commercial species of prawns. The existing methods of fishing, preservation, transportation and marketing are very poor. The resources for the development of prawn industry are immense in this country. If the industry is properly organised on firm scientific and technological basis, it is certain to have a great future.

ANTHROPOLOGY AND ARCHÆOLOGY

President: Dr. N. P. Chakravarti

EPIGRAPHY AND ANTHROPOLOGY

After paying a tribute to the departed anthropologists, Rai Bahadur Sarat Chandra Roy, Rai Bahadur Ramaprasad Chanda, Sir Flinders Petrie, Sir Arthur Evans, Monsieur Joseph Hackin and Sir J. G. Frazer, Dr. Chakravarti has reviewed the outstanding features of the work of the Archæological Department of the Government of India during the last year.

In the Sabarmati valley in Gujarat materials have been collected which are likely to throw some interesting light on the history of the Paleolithic, Neolithic and Iron Ages of India. A systematic excavation at Ahichchhatra, the capital of the ancient Panchala country, during the last two seasons, revealed the existence of five layers, virgin soil being reached 77 feet below datum. From the top, the first two layers belong to about the ninth and tenth centuries A.D., yielding Gadhaiya coins of Vigraha and Adi-Varaha types. The third stratum yielded an official Gupta sealing and evidently belonged to the Gupta period. The fourth

stratum was of the later Kushan period. The fifth which yielded coins of the Panchala type belonged to the Kushan period if not to the Sunga period. This ancient city was enclosed on all sides by massive ramparts of mud encased later in bricks with a network of bastions. Two large temples were found rising up in diminishing tiers, with a pradakshina-patha in each tier. These were two of the nine Deva temples found by Yuan Chwang. A number of terra-cotta figurines have been found in the place including the Mother Goddess, Mahishasuramardhini, etc.

Sir Auriel Stein explored the banks of the dry bed of the Ghaggar (or the Vedic Sarasvati) and discovered a large number of new sites dating from the chalcolithic times to the Kushan period. The more eastern of these sites date from the Kushan period while the more western at Derawar and Sandhanwala with their black-on-red and other painted pottery are connected with Mohenjo Daro culture. These researches have a direct bearing on the problem of desiccation in Asia.

Proceeding to his main theme of the connection of epigraphy with anthropology, Dr. Chakravarti summarised the history of writing as explained by Edward Clodd (*Story of the Alphabet*) though the Memonic, Pictorial, Ideographic and later stages and opined that epigraphy was invaluable for the study of anthropology, since epigraphs record authentically much valuable information about ethnic tribes, their customs and sociological culture; Asoka's inscriptions mention the Kamboja, Gandharas, Rathikas, Bhojas and Pitinikas. Associated with the Yavanas were the Scythian Sakas, the Kshaharatas and the Kushans, the last of whom according to Sten Konow belong to the stock *Homo alpinus* from Chinese Turkistan and are undoubtedly Iranian. Samudra Gupta's Allahabad inscription mentions a number of autonomous tribes such as the Malavas, Arjunayanas, Yaudheyas, Madrakas, Abhiras, Prarjunas, Sanakanikas, Kakas and Kharaparikaras. Other inscriptions mention the Hunas, the Bhils, the Gonds and even the Todas. The inscriptions serve the study of social anthropology by giving the traditional origin of many ruling families and by suggesting the foreign elements among the people of the country who were absorbed into Hindu society and also the matrimonial relations of indigenous and foreign ruling families. Light is thrown also on the development of the castes, of the gotras, of the matrimonial problems, etc.

Concluding Dr. Chakravarti hoped that the value of inscriptions in the study of anthropological problems would not be lost sight of by future scholars. M. H. KRISHNA.

MEDICAL AND VETERINARY SCIENCES

President: DR. F. C. MINETT

INFLUENCE OF CLIMATE ON THE INCIDENE OF DISEASE

DR. MINETT advocates a much closer liaison between Medical and Veterinary Workers in India as joint discussions and better collaboration between them, on the lines obtaining in Europe and America, would be of immense benefit to both professions. He next deals at length with the subject-matter of his paper "The Influence of Climate on the Incidence of Disease". This is a rather new field of investigation especially with reference to the domestic animals in India. Dr. Minett has been collecting all available and, as far as possible, authoritative information from the Provinces and also from the Indian States with regard to the incidence and spread of the several epizootics in the different seasons. Considering that India is a Continent where seasonal conditions vary considerably in the several parts of this country it is, indeed, a very difficult and a very long problem which only one of Dr. Minett's ability and experience could explore and elucidate. But the results of his investigations will have far-reaching and immense value in the prevention and control of epizootics. An accurate knowledge of the direct and what is equally important, the indirect influences, through changes in soil and fodder grasses by the seasonal variations, on the host and on the parasite and on the "Carriers" would be of utmost significance and we will be looking forward to Dr. Minett's valuable findings in this direction. S. D. A.

AGRICULTURAL SCIENCES

President: RAO BAHADUR Y. RAMACHANDRA RAO

THE NEED OF PLANNING ON AN ALL-INDIA BASIS IN CERTAIN ASPECTS OF AGRICULTURAL ENTOMOLOGY

INSECT pests in the Indian Peninsula can generally be classified as, firstly, those that are known to appear year by year on certain crops at particular seasons, mostly confined to particular localities and secondly, those, that have a considerable degree of mobility and that are capable of migrating long distances from the points of their origin. The Provincial Entomologists are well able to study and devise appropriate methods of dealing with the first group of pests; as regards the second group, as in the case of the Desert Locust, for example, an all-India agency is necessary to collect information on the movements of the pest from all likely breeding places, and circulate a warning to the provinces likely to be affected. While, such an agency is already functioning in respect of the Desert Locust, none has yet come into existence to deal with two other Indian locusts of potential danger, namely, the Bombay Locust and the Migratory Locust. Moreover, sufficient information about the breeding grounds, and areas of distribution and migration of these locusts has not been available; nor has any knowledge of the factors that are likely to favour the mass multiplication and swarming propensity of these locusts been gained so far.

Besides locusts, other insects like the paddy Army worm in South India, and cutworm in Bihar, are pests that migrate and spread over considerable areas during certain years. The Deccan grasshoppers invading contiguous areas in four different political territories is a

problem by itself requiring extensive studies by a central body operating in all the territories as a single unit.

The case of the great locust infestation of South India in 1878 is extremely interesting. Severe infestation had occurred over the whole of the Carnatic and Mysore and part of the Deccan. Though it is true that the invasion was an abnormal development, due to unusual drought condition in 1876, it would show that there is nowhere a real immunity in South India. If the centres of outbreak are situated in the grass areas of the hill ranges, there is every likelihood of a recurrence of locust outbreak if conditions should become favourable.

Old records of about sixty years ago, regarding the locust invasion of 1878 recovered from Government offices, have given very valuable information about the migratory locust.

The vital need would appear to be a well-thought-out plan of research, on an all-India basis, by a central body of agricultural scientists, including entomologists, who should tackle such problems as cannot obviously be worked by a provincial agency. Such problems may include investigation on pests capable of migrating from one province to another, like the Bombay locust, the Deccan grasshopper and the Army and cutworms, and also research in matters of fundamental importance. In addition, the results of work undertaken by provincial authorities that remain unpublished for long periods for want of facilities and opportunities, should be collected periodically and examined by a central agency, for preventing overlapping in research and also for the purpose of pooling of available knowledge useful to the whole of India. The recommendations of this body could later be considered by the Imperial Council of Agricultural Research for sanction of funds, for publishing useful records and making them available all over India. It is with the help of central organisations that much of very necessary and important investigation about certain insect pests of potential danger to large tracts in India, can be conducted and later, effective measures of control adopted in time.

PHYSIOLOGY

President: PROF. B. NARAYANA

THE GROWTH OF PHYSIOLOGY AS AN EXPERIMENTAL SCIENCE

PROF. B. NARAYANA has traced the growth of physiology as such and has presented before us not only the researches done in the past but also those that have been done in recent years. He has gone back to the earliest days when physiology as such was not known. Since physiology is intimately associated with anatomy, medicine and surgery, it is only natural that he has referred to these in the course of his address.

Tracing from the days of Hippocrates the author passes on to the post-Hippocratic period when two notable schools of medicine were founded in Alexandria, one by Herophilus of Chalcidan (300 B.C.) and the other by Erasistratus (260 B.C.). He then passes from the third century B.C. to the second century A.D., when Galen flourished. In Galen, the ideas of Hippocratic writers were maintained but were given a Galenic stamp.

The birth of modern science of anatomy and physiology began from the time of Andreas Vaselius who was born on the new year's night 1514-15. Vaselius' attitude was that observations and not authority were standards to be followed. He laid the foundation of experimental methods so securely that his students and disciples never appealed to him as an authority but for judgment to what could be seen and demonstrated. His book *The Fabric of the Human Anatomy*, published in 1543, was the beginning of not only of modern anatomy but of modern physiology as well. Later on in the hand of Henry anatomy took a new shape and became physiology. From this time onwards physiology was inseparably associated with anatomy and physiological explanation was acceptable only if it was anatomically possible.

Coming to the nineteenth century, physiologists like Johannes Muller, Helmholtz and Ludwig in Germany and Claude Burnard in France had considerable influence on the growth of physiology in Europe. The influence of Claude Burnard on the development of physiology as an experimental science was considerable.

It is unfortunate that physiology was not so highly developed at the time as an experimental science in Great Britain as on the continent. It was not until 1836 that Sharpey exerted his influence on the spread of physiology as an experimental science in Great Britain. Later on he induced Michael Foster to take up the study of practical physiology and to him physiology owes a deep gratitude as he took active part in founding the British Physiological Society in 1886. Gradually many centres of physiological research in Great Britain were established.

Having given a brief review of the work done by various physiologists at different centres the author discusses more fully one of the important subjects in which work has been done in recent years and further work is in progress.—"The Physiology of the Pulmonary and Bronchial Vascular System". Recent work on the subject shows that the reactions of the various parts of the pulmonary vascular bed to nervous and chemical influences are not always similar and that any given response of the lung as a whole must be considered as the resultant of a number of reactions in different parts. Recently the relationship of physiology to surgery has also been recognized and it has been realised that physiology must take the help of surgery to solve many of its intricate problems and that surgery cannot make any real advance unless it goes hand in hand with physiology.

In conclusion it has been pointed out that ways and means must be found whereby this experimental science can grow as rapidly in this country as in others. An atmosphere of research should be created in all the physiological laboratories. It will also be of very great value if attached to a department of physiology, a purely research department, called the Department of Experimental Medicine be created.

ENGINEERING AND METALLURGY

President: N. V. MODAK, B.E., M.I.C.E., M.I.E. (India), F.R.San.I., J.P.

THE THEORY AND PRACTICE OF SEWAGE PURIFICATION, WITH PARTICULAR REFERENCE TO WORKS AT DADAR, BOMBAY

BOMBAY is the first city in India to operate sewage purification works under skilled technical and scientific supervision with requisite laboratory control. Mr. Modak presents in this address, after a brief review of the modern trends in sewage disposal practice, a number of data and statistics collected at the Dadar plant, so that they may prove useful to engineers and chemists engaged in similar works in India.

The most marked trend in modernisation is the mechanisation of the treatment plant. Though economic considerations play an important part in the selection of apparatus or otherwise, plants installed in the midst of residential areas should be provided with mechanical appliances as they are helpful in minimising nuisance from smell when the various daily operations required for the efficient performance of the plant as a whole are carried out.

The next trend is in regard to pre-treatment of sewage prior to its entry into the preliminary sedimentation tanks. Pre-treatment has been developed on two lines, pre-aeration and flocculation. Pre-aeration is helpful in keeping the sewage fresh, and in the separation of grease. Flocculation is practised either with submerged paddles, having a peripheral speed of 1·5 to 1·7 f.p.s. or by blowing 0·05 to 0·2 cu.f. of air per gallon of sewage treated. Paddles give better results than compressed air. Flocculation with paddles is also adopted in the case of chemical precipitation tanks to secure thorough mixing of chemicals. Chemical precipitation is being revived, the sedimentation tanks being used for the purpose during the hot months when the sewage is very strong.

The Activated Sludge process has now passed the experimental stage and has become the most prominent mode of treatment. It can safely be relied upon to produce stable and sparkling effluents both for large and small installations, provided, skilled and scientific supervision can be afforded for its scientific operation. The process is, however, "very sensitive" and gets easily upset by factors like septicity, variations in quantity and strength of raw sewage, and the relatively large proportions of industrial wastes. Aeration is carried out with either diffused air or surface aeration, *i.e.*, mechanical agitation. The diffused air method is economical for plants of greater capacity than 4 m.g.d., while for smaller capacities the choice must be based on considerations of local conditions, and variations in flow and characteristics of sewage.

In Great Britain a number of activated sludge plants have been introduced between the existing sedimentation tanks, and the biological filters. Here the activated sludge process is employed to remove only the colloidal matter from sewage, *i.e.*, it is worked up to the clarification stage, and the filters, being more suited for the nitrification of dissolved organic matter, complete the nitrification stage.

It was thought that with the advent of the activated sludge process, the biological filters would not be considered for new installations. But as more experience was gained in the working of activated sludge process, and in particular about its sensitiveness, the troubles above mentioned were noticed, and people had to take recourse to biological filters which could withstand sudden variations in the strength and volume of sewage treated. The main drawbacks of this, however, are its large space requirement, aerial nuisance from smell and fly nuisance. These are now overcome by suitable means such as enclosing the filters and provision of forced draft aeration. Pilot plants have given such satisfactory results that this plant has a bright future, as it is cheap both in initial cost and operation cost, than the activated sludge process. Experimental work is, however, in progress to achieve further modifications of the filter such as stage filtration. There is no doubt that the old biological filter with suitable modifications will considerably influence the technique of sewage purification in the near future. An enclosed filter using forced draft aeration is in operation at Dadar from April 1941.

Sludge disposal is practised either by land treatment of sludge or burying or lagooning or drying in the open on beds. The first requires large space and has, therefore, fallen to the background, whereas the latter ones create nuisance. Pressing is adopted in many places and vacuum filters are used in several others, the dried sludge being sold as a fertiliser. Digestion of sludge in separate tanks called "digestors" is in practice, superseding the older methods. The gas obtained from digestion is used for power and fuel purposes. A single stage "digestion tank" is in operation at Dadar for five years. This is the first of its kind in India. Sixty thousand c.ft. per day of a gas of calorific value 600-650 B.T.U. per c.ft., are collected and while 25 per cent. of this is already being used for cooking and heating purposes in the K.E.M. Hospital, methods for utilisation of the remainder are being vigorously developed.

The sewage purification plant at Dadar is designed and operated for producing an effluent conforming to the standards laid down by the Rivers Pollution Board, England, for "combined" sewage. It was intended to extend this plant from 4 to 8 m.g.d., but due to conditions created by the war the work on the extension had to be deferred and the plant has, therefore, been overloaded. The total flow reaching the plant is about 10 m.g.d., out of which 5 m.g.d. are treated in the activated sludge plant, about 0·75 m.g.d. in the enclosed filter, and the remainder is bypassed after preliminary settlement into the open storm water drain close by. Full details of data and operation of the several units comprising the plant are presented and discussed.

S. K. L. NARAYANA.

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NATIONAL RESEARCH LABORATORIES

THE decision of the Governing Council of the Scientific and Industrial Research to urge upon the Government of India the imperative necessity for an immediate establishment of six National Research Laboratories with a view to speed up the industrial regeneration of the country, will be enthusiastically welcomed by every section of public opinion in India. The Council has recommended that a Central Fuel Research Station should be established at Dhanbad, which is expected to work in close collaboration with the Indian School of Mines. The subject of fuel is one of fundamental importance to Indian industry in general and to the metallurgical industries in particular. With their characteristic foresight and their reputed generosity, the Tatas have offered to finance the researches on the production of metallurgical coke to the extent of half the expenditure involved. Reserves of coal in India are limited; poor grades are extensive while the metallurgical quality does not occur in sufficient quantity to meet the needs of the comparatively colossal quantities of high quality iron ore.

The Council have also planned the organisation of a National Metallurgical Laboratory which is to be, in all appropriateness, located at Jamshedpur. The Research Laboratory will be associated with, and draw its inspiration from, the great Iron and Steel Works of the Tatas and make use of the facilities offered by the laboratories of the Government Metallurgical Inspectorate. A central Glass Research Institute is the third which has been proposed; its location is not yet decided. The Institute will engage itself on problems connected with glass technology and conduct researches on the production of high grade laboratory, ampoule and optical glasses. The National Physical Laboratory, which, in the first instance, will house the Institute for Radio Research, and the National Chemical Laboratory, complete the six for which the plans are being drawn up. The Tatas, whose munificence has brought into existence the first post-graduate Research Institute of Bangalore, have offered to make a grant of eight lakhs and a half on condition that the National Chemical Research Laboratory is located in reasonably close proximity to the great industrial centre of Bombay. This princely offer has been gratefully accepted by the Council and the Laboratory is proposed to be located at Poona.

Considering the vastness of the natural resources with which this country is blessed, and the magnitude of the industrial problems which are awaiting solution, these six National Research Laboratories would appear absolutely inadequate; but they constitute an encouraging start. It is earnestly to be hoped that the Government of India, who have recently begun to appreciate the value and indispensability of Industrial Research in advancing the economic prosperity

of this country, will favourably consider these modest proposals and extend their financial support.

During the last World War, the Western nations became alive to the need of applied research, and directed their attention to the development and organisation of research in relation to the utilisation of their natural resources. England was among the first to establish a Department of Scientific and Industrial Research. She realised her folly of having neglected organised applied research and State aid to research. Germany's far-sighted policy in this direction was brought home to the British Government even under the stress of a war which was being actively prosecuted at the time. Canada and Australia followed the example of their mother-country. India got an Industrial Commission who published a comprehensive report, which recommended the establishment of a Metallurgical Research Institute at Sakchi (Jamshedpur), a central Chemical Research Institute and an Imperial Engineering College.

After carefully examining the industrial deficiencies of India, the Holland Commission drew attention to "the extraordinary extent to which the country is dependent upon sources of supply for the raw materials and manufactured articles necessary in the life of a modern civilized community". The Report stated that "the incompleteness of our existing system of industries, has been subsequently brought into prominent notice by the interference with industrial supplies from overseas due to war. This constitutes a serious national danger, the extent and gravity of which will be more clearly realised if we refer in detail to some of the more important manufactured *materials* or *articles* which are not at present made in India, although the basis of their production exists in the form of raw material." After discussing the availability of the raw materials—mineral, chemical, vegetable and animal—and after emphasising the necessity of establishing industries for the utilisation of these raw materials, the Commission concludes, "The list of industries, though their products are essential alike in peace or war, are lacking in this country, is lengthy and almost ominous. Until they are brought into existence on an adequate scale, Indian capitalists will, in times of peace, be deprived of a number of profitable enterprises, whilst in the event of war which renders transport impossible, India's all-important existing industries will be exposed to the risk of stoppage, her consumers to great hardship and her armed forces to the gravest possible danger." The Report of the Holland Commission was shelved and after the lapse of twenty-five years, the country has realised with bitterness how prophetic these words have been!

During the same period of a quarter of a century, it is heartening to study and reflect how Russia under the ægis of its own free and National Government, evolved her destiny. In 1915, Tsarist Russia was an economically backward country. Her autocratic form of government acted as a brake on the development of her forces of production, which was responsible for her national poverty and economic dependence on the more advanced countries despite her vast natural resources. In other words, Russia found herself very much in the same position as India continues to find herself to-day. Yet, during the short span of twenty-five years, Russia's achievements in the field of science and technology, have astonished the world; she has organised her industries, developed her natural resources and built up an industrial might which has staggered the German armies on the battlefield. She is now reckoned as first-rate power among the nations of the earth. This supremacy, Russia has attained through the hard and patriotic work of thousands of her scientists and technologists who have solved problems of applied research in hundreds of well-equipped and lavishly endowed laboratories of the Soviet Government.

The National Research Laboratories have a great part to play in the future development of the natural resources of this country. We have every hope that the proposals of the Council of Scientific and Industrial Research to establish the six National Research Laboratories will be actively supported by the Government of India.

SHARKS AND SHARK-LIVER OIL

BY
PROF. R. GOPALA AIYAR
(*University of Madras*)

SHARK-LIVER OIL is rapidly taking the place of cod-liver oil in this country, owing to war conditions. It is well, therefore, to direct the attention of everyone interested, to some of the problems that have to be solved, if this valuable indigenous industry is to be built up on sound lines, so that, after the war, the need for importing foreign oil would have ceased to exist.

Attempts are being made by the Government of India and some of the maritime Indian States like Baroda and Travancore to encourage and foster production of shark-liver oil. A considerable amount of oil can be obtained from a single liver and the manufacture of sufficient quantities of liver oil and vitamin concentrates is well within the range of practical realities, provided the opportunity now afforded by the war is utilised to the fullest extent to place this industry on a firm footing.

Though correct data are not available, there is every reason to believe that there is an abundant supply of elasmobranchs on the Indian coast. The commonest forms are species of the genera *Scoliodon, Carcharinus, Hemigaleus, Carcharius, Sphyrna, Galeocerdo* and *Cestracion,* mentioned in the order of their relative abundance. Livers of other elasmobranchs such as skates and rays, belonging to the genera *Pristis, Rhyncobatus, Rhinobatus, Dasybatus* and *Trygon* are also tapped for oil.

Much work has already been done on the analysis of the vitamin A content of these fish oils, particularly at the Nutrition Research Laboratories, Coonoor. Potency for vitamin A has been shown to be very high for several species. Sharks like *Carcharinus gangeticus* yield as much as 97,500 I.U. of vitamin A per gramme of oil, while in others it may be as low as 150 I.U. The average value of a number of samples of oil has been found to be 12,000 I.U. per gramme. Compared to this, its vitamin D potency is rather low. The oil that is placed on the market is a standardised product having a vitamin A potency of 1,500 I.U., and a vitamin D potency of 100 I.U. per gramme, the latter being made up by the addition of synthetic vitamin D in the form of calciferol.

While everyone would agree that the industry should be developed with all rapidity, it is at the same time also highly desirable that the biological aspect of the question should not be lost sight of. The demand for elasmobranch livers has greatly increased recently. A visit to the great fishing centres like Pamban, Tuticorin and Calicut gives ample evidence of this. Elasmobranchs which afford material for this valuable oil, are mostly viviparous, *i.e.,* they, like the mammals, bring forth their young ones alive. Several young ones may be borne at a time. Some species of *Scoliodon* give birth to as many as 13-14 embryos. Larger forms of shark like *Galeocerdo* may give birth to as many more embryos. But, here there is no comparison with the millions of eggs produced by the bony fishes.

Fertilisation is internal and the period of gestation is pretty long, lasting for several months, and in some cases even extends to over an year, the embryos being retained in the uteri till they are considerably advanced in development. These are characters which set a natural limit on their multiplications. The question, therefore, should be asked whether it is not wise, even at this stage, to start thinking as to the ways and means necessary to ensure a steady supply of these fishes. In doing so we shall only be profiting by the experience of other countries—experience gained at considerable loss and expenditure. It will be obvious that considering the viviparous condition and the long period of gestation, if female sharks with their young ones are destroyed, wholesale mortality will result. Such destruction, irrespective of sex, size and condition of the animals would spell disaster to the industry, sooner or later.

There is very little liver in the young ones to be of much use, and such livers are very poor in their oil contents. It would, therefore, be agreed that, as far as possible, destruction of fully developed young ones, about to be born, should be avoided. If at the time of capture the period of gestation is very nearly over, the parent readily drops her burden into the sea. *Ætobatis narinari* actually jumps out of water and drops back with a splash to facilitate

emergence of embryos. If, therefore, during the process of handling the captured fish, embryos drop into the boats they should be immediately returned to the sea. There is then a fair chance of several of them surviving, even though birth has been slightly premature.

It is known that these fishes attain maturity only after reaching a definite size, and most of them grow even after maturity, with the liver size and quantity of oil increasing with age and size. We know, for instance, that *Scoliodon sorrakowah* becomes sexually mature when it attains a length of 15″ to 18″. Similarly *S. dussumieri* reaches a length of 20″ to 23″ at sexual maturity. Maturity size is not the same for all species of elasmobranchs. Thus, species of *Galeocerdo* grow to a length of 12 to 15 feet and maturity size is correspondingly high. Hence, if it is possible to find a minimum size which will approximate with the first maturity size, destruction of undersized fish can be prevented by legislative restrictions, and, if the minimum marketable size is fixed at a slightly higher level than the first maturity size, it will enable the fish to shed their first brood into the sea, thus automatically ensuring a supply. But our knowledge in regard to the rate of growth and age at sexual maturity of the different elasmobranchs is meagre, and extensive investigations will have to be carried out in biological stations and by the fisheries departments in the country, to make such information available for all the species. A true conception of their age, growth-rate and movements can only be obtained by marking experiments involving co-operation between fishermen and workers in biological stations. Again, we are almost completely in the dark regarding the breeding grounds and the breeding season of the different species. It can only be said that, like many other tropical marine animals, some of them have an extended reproductive period.

Europe and America, where intensive fishing has led to depletion of certain species of fish, have resorted to legislation for conservation and this has resulted in the restoration of such fisheries. A well-known example is the northern Pacific halibut fishery. In Malabar, indiscriminate fishing of *Sardinella longiceps* has given a setback to the supply of sardine oil. On the east coast, *Trichiurus savala* is another which is caught wholesale, many of them in a very immature condition. In India fishing operations are not carried out in any such intensive scale as in the Western countries and Japan, and the problem of overfishing may not be pressing for the bony fishes. But the need for conserving our shark supplies stands on a different footing on account of their viviparous habits, the limited number of young ones produced and the long period of gestation—habits which make them peculiarly liable to quick depletion if indiscriminate methods are adopted.

Any attempt to bring any sort of control on fishing methods must largely depend on the data available in regard to the life-history of the fishes in question. Improved methods of fishing must be employed and active propaganda conducted. Even such a detail as failure to choose a suitable name for a commercial fishery product might lead to prejudice in the public mind. The United States Bureau of Fisheries converted the spiny dog-fish of the Atlantic coast into a valuable asset by changing the name of the fish for trade purposes. People might eat "cat-fish", but are prejudiced against "dog-fish" and so the Bureau changed the name of the latter into "grey-fish", which is 'descriptive, not pre-occupied and altogether unobjectionable'.

There is a vast field for research to acquire further knowledge in regard to the life-histories of the various species of elasmobranchs, their growth-rate, size at maturity and migratory movements. A systematic study of the various forms in regard to their vitamin potencies during different parts of the year and during different phases of their life-history has to be made. There is no doubt that such investigation will result in valuable information which will be helpful in solving the problems that confront us to-day. In this work the Biologist, the Biochemist and the Fishery-Expert can play an equal and honourable part. It will entail long and planned research and meanwhile, the statement of Dr. E. S. Russell "that upto a point you can increase yield by increasing fishing but after this maximum has been reached the more you fish the less weight of fish you catch and that there must be for every fishery an optimum rate of fishing" might well be borne in mind by Government officers and others interested in the welfare of the shark-liver oil industry.

LETTERS TO THE EDITOR

THE MODE OF ACTION OF VITAMIN D

Several hypotheses have been put forward from time to time to explain the mode of action of vitamin D, but none accounts satisfactorily for all or most of the observed phenomena. The earlier view that vitamin D directly influences absorption of calcium from the intestine has been disproved by evidence published by Patwardhan and Chitre.[1] Sufficient evidence on the other hand is forthcoming to show that vitamin D influences the retention of calcium and phosphorus in the body and thereby maintains a proper balance between the needs of the bones and soft tissues. That the vitamin does not influence deposition of bone by local action has been demonstrated by Robison and Rosenheim[2] with bone slices in calcifying solutions. Under these circumstances the suggestion made by Harris[3] that rickets is essentially a disease of blood rather than the bone seems to be worthy of consideration.

Investigation of the concentration of various chemical constituents of blood serum, *viz.*, Ca, P (acid-soluble, total and inorganic), Mg, Cl, total protein, albumin and globulin, total base, etc., in rachitic and normal children showed that apart from calcium and phosphorus of the serum no other constituent underwent any change which could be attributed to the influence of vitamin D.

That calcium and inorganic phosphorus singly or together decrease in vitamin D deficiency is well known. The diminution of total [Ca] without a simultaneous fall in the quantity or a change in the nature of serum protein would result in a decrease of $[Ca^{++}]$ of the serum [McLean and Hastings[4]]. This is followed by the fall of the ionic product of $[Ca^{++}] \times [HPO_4^=]$ and $[Ca^{++}]^3 \times [PO_4^{\equiv}]^2$ leading to a state of undersaturation of the plasma with regard to either of these salts. In 1941, Freeman and McLean[5] showed that in induced rickets in puppies there existed a relation between the ionic product of $[Ca^{++}] \times [HPO_4]$ and calcification at the epiphysis. No such relationship could be found, according to them, with regard to the solubility product of $Ca_3(PO_4)_2$.

Our own observations on clinical rickets amply confirmed by a further study of experimental rickets in puppies show that, in fact, the calcification at the epiphyses and the solubility products of both the above salts are correlated. The critical values for the negative logarithms of the ionic products of $[Ca^{++}] \times [HPO_4^=]$ and $[Ca^{++}]^3 \times [PO_4^{\equiv}]^2$ have been observed to be 5·7 and 23·0 respectively. The corresponding values for rachitic children and vitamin D deficient animals lie above and those for normal children and control animals lie below the critical values. This observation on the influence of vitamin D on the ionic products is significant and the authors feel that it should be capable of being applied to test the state of nutrition with regard to vitamin D, especially as no such test exists at the present moment.

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Parel, Bombay,
February 3, 1943.

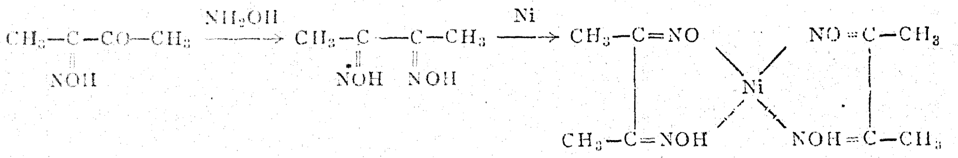
V. N. Patwardhan.
D. R. Sukhtankar.

1. Patwardhan and Chitre, *Ind. Jour. Med. Res.*, 1942, **30**, 81. 2. Robison and Rosenheim, *Biochem. Jour.*, 1934, **28**, 684. 3. Harris, *Lancet*, May 14, 1932. 4. McLean and Hastings, *Amer. Jour. Med. Sci*, 1935, **189**, 601. 5. Freeman and McLean, *Arch. Path.*, 1941, **82**, 387.

THE COLORIMETRIC ESTIMATION OF HYDROXYLAMINE

The several reactions which can be used for the qualitative detection of hydroxylamine have been reviewed by Blom (1928).[1] There exists, however, no satisfactory method for the quantitative estimation of this substance in biological material (*cf.* Lemoigne, *et. al.*, 1935).[2] We describe here a procedure which has been worked out for the colorimetric

estimation of hydroxylamine in the study of nitrogen metabolism in plants. The method is based upon the conversion of hydroxylamine by condensation with diacetylmonoxime to dimethylglyoxime which is then determined by its highly specific reaction with nickel.



By the use of nickel solution oxidised by bromine as employed by Feigl (1924)[3] for the estimation of nickel, the nickel dimethylglyoxime is obtained as a pink solution which can be estimated colorimetrically.

Reagents

A. Hydroxylamine standard, containing 0·01 mg. NH_2OH-N in 1 ml. (4·953 mg. of $NH_2OH.HCl$ in 100 ml.). The solution is neutralised to pH 7·2 with ammonia. The standard is stable for over two weeks. A standard of half this strength can also be used, but with slightly less accuracy.

B. Diacetylmonoxime in N/10 ammonia—3·6 g. dissolved in 10 ml. of N ammonia and diluted with water to 100 ml.

C. Oxidised nickel solution—0·4479 g. of $NiSO_4$, $6H_2O$ in 1 litre. For each estimation 10 ml. of the solution are treated with saturated bromine water added drop by drop till a distinct excess is present. After standing for 15 minutes, N-ammonia is added drop by drop till the excess bromine is decolorized.

Procedure

The test solution containing between 0·025 and 0·075 mg. of hydroxylamine-N is neutralised to pH 7·2 by the addition of ammonia and then treated with 1 ml. of the diacetylmonoxime solution (B). After allowing to stand for half-an-hour at room temperature, 10 ml. of the oxidised nickel solution (C) are added and mixed and after five minutes made up to 25 ml. The rose-red colour which develops is compared with the standard hydroxylamine solution (A), 5 ml. of which are subjected to the same treatment as the test solution.

Table I shows that there is a reasonably good proportionality between colour produced and concentration of hydroxylamine for ranges of concentration from 50 to 150 per cent. of the standard with an error ranging from 0·5 to 3·25 per cent. The smallest concentration of hydroxylamine that can be satisfactorily determined is 0·0005 mg.—N per ml. using a standard of half the strength described above. The errors in this case are slightly higher being of the order of 1 to 4·5 per cent.

The chief conditions for satisfactory results are (1) that the condensation between hydroxylamine and diacetylmonoxime should be carried out at room temperature and a pH of 8·8 to 9, and (2) that a considerable excess (about 150 times the theoretical amount) of diacetylmonoxime should be present. These conditions are satisfied with the quantities and procedure given here. The colour produced is stable for 20 minutes.

Table I

Proportionality between Colour and Hydroxylamine Concentration

Standard and test solution made up to 25 ml. before colour comparison.

Standard: 0·05 mg. NH_2OH—N. Reading of Standard—20.

Test solution (mg. NH_2OH-N)	0·020	0·025	0·030	0·035	0·040	0·045	0·055	0·060	0·065	0·070	0·075
Readings found	..	41·3	34·3	29·3	25·3	22·4	18·3	16·9	15·7	14·6	13·7
Readings calculated	50·0	40·0	33·3	28·6	25·0	22·2	18·2	16·7	15·4	14·2	13·3
% Error (–)	..	3·25	3·00	2·40	1·20	0·90	0·55	1·20	1·94	2·80	3·00

In experiments on the hydroxylamine content of root-nodules the method gave 98 per cent. recovery of added hydroxylamine.

Full details with the results obtained on plant materials will be described elsewhere.

University Biochemical
Laboratory, Madras,
February 18, 1943.

M. Damodaran.
Kerala Varma.

1. Blom, *Biochem. Zeitschr.*, 1928, **194**, 385. 2. Lemoigne, M. Monguillon, P., and Desveaux, R., *Compt. Rend.*, 1935, **201**, 1067. 3. Feigl, *Ber.*, 1924, **57**, 758.

GROWTH IN SOME STOMATOPODS

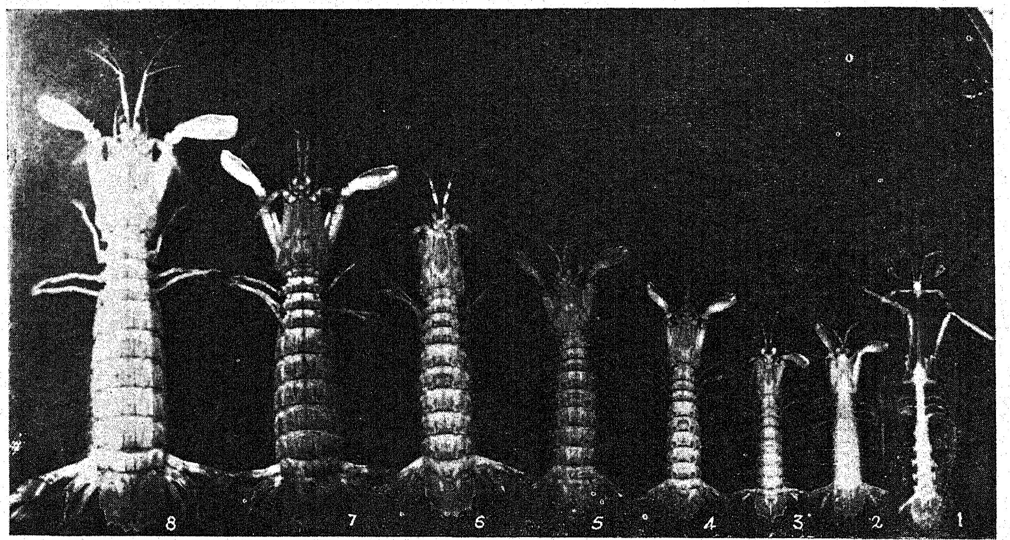
In a previous note[1] we recorded the metamorphosis of the larvæ of five species of *Squilla* and assigned them to their respective species. Since then work on similar lines has been continued and five more species of pelagic larvæ have been successfully reared through their metamorphosis, post-larval and pre-adolescent stages, and have been identified as

Squilla quinquedentata, *S. interrupta*, *S. fasciata* (?), *Lysiosquilla maculata* and *L. multifasciata*. *S. fasciata* and *L. multifasciata* have not hitherto been recorded from this coast of the Bay of Bengal. The occurrence of their larvæ in the plankton on the Madras Coast shows that the adults also are probably inhabitants of this coast.

No precise data are available regarding the rate of growth and age at sexual maturity of any species of Stomatopoda—a group that forms an important item of fisheries in certain parts of the world.[2,3] Attempts were, therefore, made to grow the post-larval forms in the Laboratory, and it was found that they flourished quite well in aquarium tanks, provided the water was changed daily and the animals fed regularly. Minced meat of the common anomuran, *Emerita asiatica* was given as routine food. Growth was found to be remarkably rapid. The post-larvæ undergo the first moult in four to eight days after metamorphosis, each moult being accompanied by a distinct increase in size. Further moults for the same species take place at definite intervals, subject however, to slight variations. While the interval between successive moults is different for different species, it becomes longer with age in every species. Measurements were taken after each moult and we now have data as to the rate of growth and the interval between moultings in a number of species. The time at which the gonads become mature is also being ascertained. Specimens over six months old are at present living in the aquarium tanks and observations are being continued. The following table which gives the information at present available, records the age and size after each moult for six species:—

		Final pelagic larva	Post-larva	1st moult	2nd moult	3rd moult	4th moult	5th moult	6th moult	7th moult	8th moult	9th moult	10th moult
S. nepa ..	Age*	..	..	5	10	15	20	26	34	44	77	114	146
	Size*	24	17	20	23	29	35	41	52	63	72	83	96
S. wood-masoni ..	Age	..	..	5	10	15	21	28	38	47	64	98	..
	Size	36	22	24	30	34	42	52	62	73	83	92	..
S. raphidea ..	Age	..	..	4	9	14	19	26	36	45	57	71	..
	Size	19	15	19	24	29	34	42	52	62	73	83	..
S. holoschista ..	Age	..	..	6	14	24	35	45	56	68	82	..	..
	Size	35	22	24	23	35	42	49	58	67	76	..	..
L. multifasciata ..	Age	..	..	5	13	21	29	43	56	73	90	106	..
	Size	14	9	11	13	17	20	23	27	30·5	33·5	37	..
L. maculata	Age	..	..	8	19	31	42	51	64	..	..	..	..
	Size	23·5	23·5	29	35	41	48	56	66	..	..	..	..

* Age, in days, after metamorphosis; and size, the maximum length in mm.



Growth stages of *Squilla holoschista* Wood-Mason.
(Almost natural size)
1, Final pelagic larva. 2. Post-larva, 12 hrs. old. 3. Post-larva, 4 days old. 4—8. Later stages after successive moults from 1st to 5th.

The accompanying photograph represents growth stages of *S. holoschista* from the final pelagic larva upto the fifth moult after metamorphosis.

The phenomenon of moulting itself is extremely rapid and is completed in a surprisingly short time. A detailed account of the work will be given shortly.

University Zoological Research Laboratory, Madras, March 3, 1943.

K. H. ALIKUNHI.
R. GOPALA AIYAR.

1. Alikunhi and Aiyar, *Curr. Sci.*, 1942, **11**, No. 2, 56-58. 2. Komai, T., and Tung, Y. M., *Annot. Zool. Jap.*, 1929, **12**, No. 1. 3. Bigelow, R. P., *Bull. Mus. Comp. Zool. Harvard*, 1931, **72**.

METHIONINE CONTENT OF FRESH WATER FISH MUSCLE

METHIONINE is one of the indispensable amino acids required for animal nutrition. An assessment of the methionine and other amino acid contents of foodstuffs is necessary for an accurate evaluation of the nutritive value of food proteins. A preliminary examination of the methionine content of some fresh-water fish muscles by a slightly modified method of Baernstein[1] has revealed that of the varieties so far examined the muscles of *Cirrhina mrigala* are the richest having a methionine content of 3·45 g. per 100 g. dry material. This compares well with figures for Halibut muscle and Shrimp muscle given by Baernstein.[2] Arranged in order of their methionine content we get

Cirrhina mrigala > *Clupea ilisha* > *Labeo rohita* > *Scieana coiter*.

Dept. of Medical Chemistry, Prince of Wales Medical College, Patna, February 13, 1943.

M. N. RUDRA.

1. *J. Biol. Chem.*, 1936, **115**, 25. 2. *Ibid.*, 1932, **97**, 663.

PETROLEUM AS A SOLVENT FOR MOUNTING MEDIA

R. A. GROAT[1] in his paper on "Two New Mounting Media Superior to Canada Balsam and Gum Damar" has studied the various solvents that could be used. He has tried the lower boiling petroleum distillates like petroleum ethers, ligroins and benzines, as well as other solvents like xylene, toluene, benzene and chlorobenzene, and finds that from considerations of cost, purity, inertness and insolubility of stains in the solvent, toluene is by far the best solvent and is slightly less expensive than xylol.

In India, at the present time, both these solvents, xylene and toluene are equally costly and unavailable. With the possibility of utilising Dhupa Balsam from *Canarium strictum* instead of Canada Balsam,[2] we thought of substituting the cheaper and more easily available petroleum for xylol. Petroleum distillates over various ranges—between 80°-120°, 125°-140°, 145° C. and above, were collected and tried. The first distillate—below 120° C. was unsatisfactory as it evaporated very quickly. The fraction above 145° was also unsuitable as its rate of drying was very slow. The middle fraction, boiling between 125°-140° C., was found highly suitable. Attempts were made to utilise this fraction in place of xylol, throughout the processes of manufacture of a slide including the grading up of the fixed material. The results have been very encouraging. This fraction of the petroleum seems to have precious little or no action in dissolving away the stains used. Moreover, when compared with xylol it has the advantage of being perfectly neutral and remaining unchanged through any length of time whereas xylol has the tendency of gaining colour with time. One gallon of ordinary petroleum will yield about a pound of the 125°-140° C. fraction.

Intermediate College, Tumkur, February 26, 1943.

B. THIRUMALACHAR.
M. K. MADHURANATH.

1. Groat, R. A., *Anat. Record*, May **1939**, **74**, No. 1, and Suppl. No. 1, May 1939. 2. Thirumalachar, B., "An Indigenous Substitute for Canada Balsam," *Proc. Ind. Sci. Congress*, 1942.

A NEW METHOD OF SYNTHESIS OF δ-*DIETHYLAMINO-ISOPENTYLAMINE* REQUIRED FOR THE MANUFACTURE OF ATEBRIN

THE chief obstacle in the way of preparation of Atebrin in India at the present moment is the scarcity of some important chemicals such as sodium, thionyl chloride, ethylene-chlorhydrin and ethylacetoacetate. None of these is at present manufactured in this country.

The usual method of preparation of Atebrin (standardised recently in these laboratories by Guha and Mukherjee) involves the use of these four chemicals for the preparation of δ-diethylamino-isopentylamine (I). As there appear to be no immediate prospects of supply of these chemicals in India, it occurred to us to investigate alternative methods of preparation of the amine (I) avoiding the use of the four above-mentioned chemicals.

It has now been found that this amine (I) can be obtained by the following series of reactions:—

$$Cl{\cdot}CH_2CH(OEt)_2 + NHEt_2 \longrightarrow \underset{(II)}{Et_2NCH_2CH(OEt)_2} \longrightarrow \underset{(III)}{Et_2NCH_2CHO}$$

$$\underset{(III)}{Et_2NCH_2CHO} \xrightarrow{+\ \text{acetone}} \underset{(IV)}{Et_2NCH_2CH{=}CHCOCH_3} \xrightarrow{H_2} \underset{(V)}{Et_2N(CH_2)_3COCH_3} \longrightarrow \underset{(I)}{Et_2N(CH_2)_3\overset{NH_2}{\overset{|}{C}}HCH_3}$$

Chloroacetal prepared from alcohol and chlorine, has been condensed with diethylamine (*Ber.*, 1897, 30, 1504) to give 30 per cent. yield of the acetal (II); and 66 per cent. of unreacted diethylamine is recovered. The hydrochloride of (III) is obtained from (II) in quantitative yields, and condensed with acetone in presence of alkali to form *diethylaminopentenone* (IV), (b.p. 103-5°/30 mm., n_D^{26}, 1·4453) in about 15 per cent. yield. On reduction with hydrogen in presence of Raney's nickel, (IV) furnishes diethylaminopentanone (V) (yield, 80 per cent.) which is converted to the required amine (I) in the usual way. The yields of compounds (II) and (IV) require further improvement to make this process commercially successful.

In order to conserve the costly diethylamine as much as possible, the following reactions, represented schematically below, have been tried:

$$ClCH_2CH(OEt)_2 + CH_3COCH_3 \rightarrow$$

$$\rightarrow \underset{(VI)}{ClCH_2CH(OH) \cdot CH_2COCH_3} \rightarrow$$

$$\rightarrow ClCH_2 \cdot CH{=}CH \cdot COCH_3 \; (VII) \xrightarrow{NHEt_2} (IV)$$

Attempts to dehydrate the compound (VI); (yield 38 per cent.; b.p. 128°/15 mm.; d_{30}^{30}, 1·086; $n_D^{26 \cdot 5}$, 1·4151) to (VII) have not been successful, either complete decomposition or resinification taking place.

Organic Chemistry Section,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science, Bangalore,
March 12, 1943.

P. C. GUHA.
P. L. NARASIMHA RAO.
T. GEORGE VERGHESE.

EXCITATION AT THE ANODE AND THE CATHODE

THE fact that on closing the current through a nerve, the excitation wave starts from the cathode shows that cations are important agents. How, then, is the fact of excitation at the anode, which occurs on breaking the current, to be explained. It is pointed out by Kieth Lucas (1912) that "the one feature which is common to the cathode when the current is made, and the anode when the current has just ceased to flow, is an increase of the concentration of cations above the value which occurred at each of these points immediately before". At the anode, however, the concentration of cations only rises to its normal level by diffusion, after having been decreased.

Experiments on unstriated muscle have shown, that ions may produce their effects, either excitation or inhibition, after their concentration having been lowered below normal, is again raised to normal, this concentration previous to being lowered, having no such effect. Thus frog stomach may contract if it is at first placed in a solution, free of sodium chloride, and then the concentration of the latter being raised to normal (Singh, 1939); instead of contraction, inhibition may be produced, probably due to the fact that the effect of sodium is inhibitory, and that of chloride excitatory, the result depending upon as to which of these actions predominates. In the guinea-pig uterus, the normal concentration of potassium in the mammalian saline has no appreciable effect; if the muscle is deprived of potassium for ten minutes, its reintroduction produces marked inhibition (Singh, 1942).

The muscle thus accommodates to normal concentration of ions.

Brigade Laboratory,
Allahabad,
January 18, 1943.

INDERJIT SINGH.

1. Kieth Lucas, *Proc. R. Soc.*, 1912, **85B**, 495. 2. Singh, I., *J. Physiol.*, 1939, **96**, 367. 3. Singh, I., *Ind. J. Med. Res.*, Oct. 1942.

ON THE MOUTH-PARTS OF THE INDIAN GLOW-WORM, *LAMPROPHORUS TENEBROSUS* WLK.

THE larval mouth-parts of *Lampyris noctiluca* L. and *Luciola gorhami* Rits. have been worked out by Haddon, K. (1915) and Mehta, D. R. (1932) respectively. Paiva, C. A. (1919) and Hutson, J. C., and Austin, G. D. (1924) have described only the habits and life-history of the Indian Glow-worm, *Lamprophorus tenebrosus* Wlk. The mouth-parts of this form have not been worked out in detail till now.

The following observations were made from material collected from the College premises, Tambaram, Chingleput Dist. The adult male head is hypognathous and the mouth-parts are mandibulate with minimum growth of hairs. The larval and female head is prognathous and highly retractile. The head capsule is smooth and dorso-ventrally flattened with the epicranial suture well-emphasised. The labrum is an inflexed plate forming the roof of the buccal cavity. The mandibles are strongly falcate with double condylar articulations with the head capsule. The maxillæ are fused into a compound labio-maxillary plate, the major portion of which is formed by the stout stipites. The female mouth-parts resemble those of the larva but slightly modified. The larval mouth-parts are wonderfully adapted for attacking and consuming the snails (*Ariophanta ligulata*, *A. bistrialis*, etc.) on which they feed. The maxillary palp is 5-jointed in the male, 4-jointed in the female and 3-jointed in the larva. The labial suture is conspicuous and the labial palp is 2-jointed throughout. The mouth-parts of the larva are characterised by the enormous development of hairs all round

the mouth, the presence of distinct brush-like structures on the labio-maxillary plate, the occurrence of a mandibular canal, the formation of a filter mechanism in front of the mouth and the presence of a conspicuous hairy sheath attached to the base of the mandible serving as a filter for the liquid food. The prelabium is provided with a conspicuous triradiate sclerite which supports a posteriorly directed prelabial brush. The food is crushed in the larva by the stiff hairy tufts and taken in the liquid state both through the mandibular canal and the mouth opening, exactly as in the larva of *Lampyris noctiluca*. The buccal cavity leads into the pharynx which is differentiated both in the adult female and larva into an anterior strongly chitinised prepharynx and a posterior membranous sac. It is interesting to note that while the larvæ are voracious feeders on snails, the adults take little or no food.

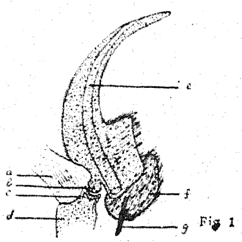


Fig. 1

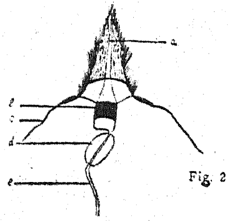


Fig. 2

FIG. 1. Right mandible—Ventral view (Larva)

a.—Antenna; *b.*—Postartis; *c*—Postcoila; *d*—head-capsule; *e.*—Mandibular canal; *f*—Prostheca; *g*—Chitinous rod for attachment.

FIG. 2. Hypoharynx and pharynx (Larva)

a.—Median groove; *b.*—Prepharynx; *c.*—Attachment to head capsule; *d.*—Pharynx ("Postpharynx") · *e.*—Oesophagus.

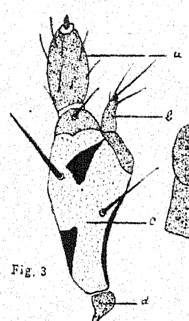


Fig. 3

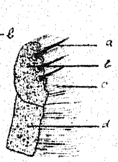


Fig. 4

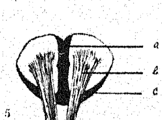


Fig. 5

FIG. 3. Left maxilla—Dorsal view (Larva)

a.—Maxillary palp; *b.*—Galea; *c.*—Stipes; *d.*—Cardo

FIG. 4. Maxillary lacinia (Larva)

a.—Spine; *b.*—Apical joint; *c.*—Hairs; *d.*—Basal joint.

FIG. 5. Prelabial armature—Dorsal view (Larva)

a. & *c.*—Triradiate Sclerite; *b.*—Prelabial brush (Diagrammatic).

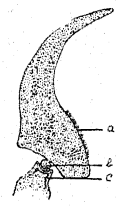


Fig. 6

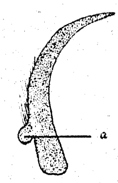


Fig. 7

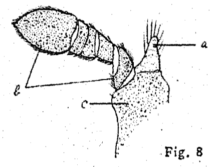


Fig. 8

FIG. 6. Right mandible (♀)

a.—Reduced basal brush: *b.*—Postartis: *c.*—Postcoila.

FIG. 7. Right mandible (♂)

a.—Postartis.

FIG. 8. Right maxilla—portion (♂)

a.—Galea; *b.*—Maxillary palp; *c.*—Stipes.

Zoology Department,
Madras Christian College,
Tambaram,
January 16, 1943.

J. SAMUEL RAJ.

FIRST RECORD OF THE SEXUAL FORMS AND OVIPAROUS REPRODUCTION OF WOOLLY-APHIS, *ERIOSOMA LANIGERUM* HAUSM. FROM KASHMIR, INDIA

THE woolly-aphis (*Eriosoma lanigerum* Hausm.), a native of the eastern half of N. America, gradually spread, to become a pest of apple (*Pyrus malus*), in most other apple-growing tracts of the world. Owing to changed environmental conditions and absence of American Elm (*Ulmus americana*) the behaviour and life-history of the aphis altered considerably in its new habitat.

In India, the woolly-aphis was found well established as early as 1891 (Atkinson)[1] and has at present assumed pest form in all the apple-growing tracts of the sub-continent. Detailed life-history studies made and reported so far in India make no mention at all about the existence of sexual forms and oviparous reproduction. The authors in their study of the aphis during the past three years have established their presence and their observations confirm those of other workers in the West.

In Kashmir, the apterous aphis (found on apple) reproduces asexually and the winged form appears twice a year—May-July and August-November. The winged forms appearing in the former period develop from the apterous colonies and their number remains small throughout. They live from five to six days and reproduce asexually nymphs which resemble those of apterous forms in all respects. In this respect these winged forms are like the spring-winged form found in America and are capable of spreading the infection by their flight from one locality to another. The second instalment of winged form which appears in the latter period (end of August-November) is found in very large numbers for about two months. Four to seven nymphs are laid by a single-winged aphid during its average adult life of six days. The nymphs are peculiar in being devoid of mouth parts; five antennal joints are present throughout life; sexes can be differentiated by means of size, colour and structure. The male (0·55-0·60 mm.) is smaller than the female and has a reddish-brown-purplish tinge; the fourth and fifth antennal joints have each a prominent sensorium; the labium is absent and the trophic tubercle is vestigial; the terminal segments of the abdomen are prominently hairy; the claspers are small and curved and the aidegus protrudes in between.

The female (0·7-0·9 mm.) is reddish-brown in colour and has a larger width of body. A single egg is easily seen in the abdomen from its very early stages and with age the egg becomes more marked.

The male is short-lived (twelve days) while the female survives for a period of about twenty days. Both moult regularly four times at an interval of three to four days; the female dies in the process of laying her egg; the egg is deposited near the crown of the root of the apple plant, being light-brown and later becomes deeper coloured, and long (0·32 mm.) and ovoid in shape.

Gratitude is expressed to the Imperial Council of Agricultural Research and His Highness' Government, Jammu and Kashmir, who are financing the Research Scheme on the San-Jose Scale and woolly aphis in *Kashmir*.

Dept. of Agriculture,
Srinagar,, Kashmir,
February 10, 1943.

M. R. Fotedar.
A. P. Kapur.

1. Atkinson, *Ind. Museum Notes, Calcutta*, 1891, **2**, 52.

THE AERIAL ROOTS OF *PLUMERIA ACUTIFOLIA* POIR.

Plumaria acutifolia (Apocyanaceæ), commonly known as "Pagoda tree", is characterised by false dichotomous branching and parallel veined leaves.

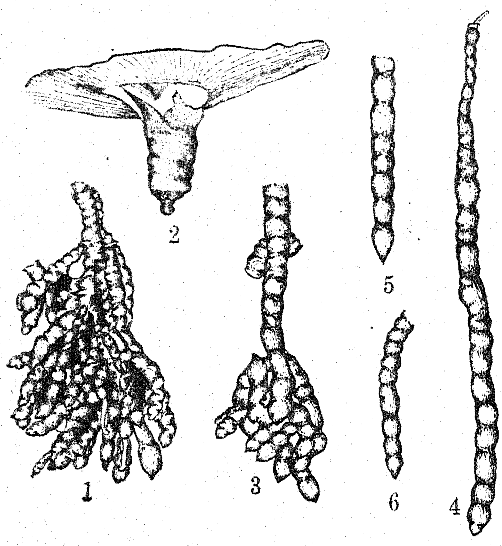
An interesting feature of the plant is the occurrence of aerial roots on the under-surface of the branches, commonly noted on plants over six feet in height. As a rule, the roots appear with the break of the monsoon, when new leaves arise after defoliation. The aerial roots remain active till the end of the rainy season when they become dried and shrivelled and remain as entangled mass of dark filiform processes.

Aerial roots are present only on the under-surface of the obliquely growing branches. In a few instances they occur on the upper surface of the stem, particularly in regions where more than two branches bifurcate. They have not been found to come out through the lenticels. They always occur in isolated patches and are never present on current year's shoot but are abundantly developed on previous year's branches and appear as a "coralloid mass" (Fig. 1). Their development appears to be as follows:—A single root (4 to 8 mm. in thickness) pierces the stem and after growing for a distance of a centimetre or two stops development (Fig. 2). It has a constricted appearance and the proximal portion develops a green colour while the distal portion remains white and the tip though somewhat swollen has the normal appearance. Very soon the tip dries up and becomes blackish-brown in appearance. Lateral roots then develop, which again after growing for 1 to 3 centimetres become arrested in development and these in their turn give out lateral roots (Fig. 3). In this way a large number of delicate roots become aggregated in a coralloid mass. In rare instances a comparatively thinner primary root was seen to remain unbranched, and to grow for a distance of 2 to 4 centimetres and then stop development (Fig. 4). A characteristic feature of these aerial roots is their moniliform appearance (Figs. 5 and 6).

The growth and development of the roots is not continuous but intermittent. Under drought conditions the tips of the roots dry up, and with the fall of the rain, lateral roots are again given out. If, however, the dry spell is not of sufficient duration, the tip does not dry up and the individual root continues development, and shows an increase in length (Fig. 4). Once the tip gets shrivelled further growth in length is arrested and lateral roots are given out which, as usual, are endogenous in origin.

Particularly when the atmospheric precipitation is very high, root hairs are produced in the younger roots. They are produced in acropetal succession and occur from the first swollen region of the root to a few millimetres behind the apex, which is covered by a root cap. The root hairs have an average length of 179 microns and show the usual features,

They are not present in the older roots and disappear after the rains.



FIGS. 1-6. Explanation in text. (× 5)

Anatomical study of the aerial roots show the presence of a large cortex and a central stele with exarch vascular bundles. There are eleven primary protoxylem and protophloem elements. Secondary growth occurs mainly in the primary roots. It is of very short duration and a complete woody cylinder is not formed. A notable feature of the primary roots is the presence of isolated medullary strands in the central region of the stele.

The formation of periderm takes place in all the roots in course of time. Lenticels occur only on the comparatively thicker primary roots, and they are entirely absent on the younger roots.

Akhtar[1] seems to be the only worker who has recorded the occurrence of aerial roots of *Plumaria acutifolia*. He does not, however, mention the occurrence of root hairs. Root hairs have been found to be present in the adventitious aerial roots of Sorghum by Vijayaraghavan and Rao[3] and they are of opinion that these serve as organs for absorption. Root hairs are also found to occur in the aerial roots of Banyan during rainy season. Recently Thirumalachar and others[2] have recorded the presence of root hairs on the aerial roots of *Heptapleurum venulosum*. These are thick-walled, and show characteristic serrations. They act both as anchoring and absorbing organs. In the material studied root-hairs are produced only during very humid weather and as such undoubtedly act as organs for the absorption of liquid water which accumulates in the capillaries produced by the close association of a large entangled mass of filiform roots.

Anatomical evidence reveals that the moniliform appearance of the younger roots is due mainly to the very great enlargement of the cortical cells in the regions where transverse fissions have taken place in the periderm. The initial increase in the size of the cortical cells produces a radial pressure on account of which the periderm is ruptured at certain regions. At these regions the cells become much larger in size on account of the relaxation of the pressure, whereas in regions where the periderm remains intact the cells are unable to enlarge. It is at these regions that the constrictions are noted. Repetition of this process appears to give a moniliform appearance to the root. Fig. 7 illustrates the point very clearly. It will be seen that the periderm

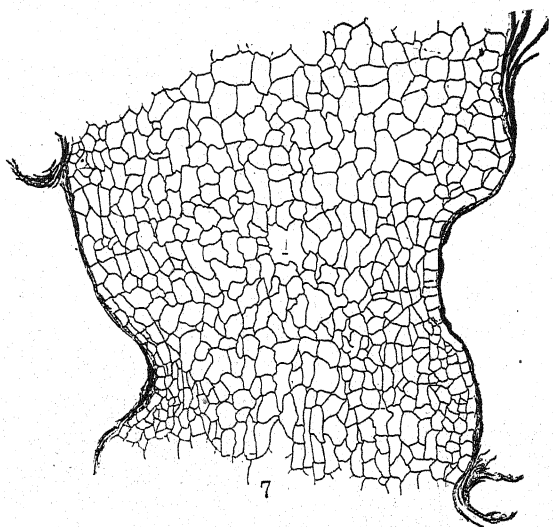


FIG. 7. L.S. through portion of a moniliform root. (× 30)

is disrupted at the regions where the swellings occur. The size of the cortical cells in the constricted and non-constricted regions also supports this interpretation. It is, however, difficult to state at this stage of the investigation why the rupture of the periderm takes place so regularly and periodically in these roots. The author is led to believe that this may have something to do with the variation of the humidity of the atmosphere.

My thanks are due to Prof. G. P. Majumdar for helpful suggestions.

Department of Botany,
Calcutta University, I. BANERJI.
February 3, 1943.

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2. Thirumalachar, M. J., Swamy, B. G. L., and Khan, K. B. A., *Jour. Bombay Nat. Hist. Soc.*, 1942, **43**, 276.
3. Vijayaraghavan, C., and Rao, V. Panduranga, *Curr. Sci.*, 1938, **7**, No. 1, 20.

A PROLIFIC PLANT IN JOWAR *HOLCUS (ANDROPOGON) SORGHUM* BROT.

AN abnormal Jowar plant was found growing in a rose hedge in the writer's house in Poona. The plant was self-sown one and had attained

a height of 14·5 ft., with a large number of ear-heads. The plant bore in all seventeen heads from the seven upper nodes (12th to 18th). The main stem terminated in a large head. The emergence of the heads was from the apex towards the base. Secondary branches were also formed in the upper nodes. Adventitious roots were noted in 12th, 13th and 14th nodes. The plant was further interesting in that it produced ten tillers including

the one described above. This kind of growth is very rare in this species of Holcus.

Poona,
January 9, 1943. G. B. PATWARDHAN.

Ed. Note: It is since reported very regretfully that the seeds of the plant were destroyed partly by birds and partly by rats in store.

ON THE VARIATION IN THE RATE OF ELONGATION OF THE COLEOPTILE OF ZEA MAYS

C. V. KRISHNA IYENGAR[1] has recently reported that the rate of elongation of maize coleoptile shows a fluctuating course when measurements are carried out at ten-second intervals with a magnification of 3,000. He is inclined to believe that the autonomous activity of the growing organs showing a pulsating nature (Bose, 1927) and the rhythmic change of potential in the plant body at short intervals as explained by Bose (1923) might indicate the occurrence of variation in the turgidity of the plant body even at short intervals; and this variation in the turgidity might account for the fluctuations in the rate of elongation of the coleoptile.

While this explanation may be correct the writer is puzzled by the following few questions and hopes that the author will throw light on the same.

How rigorous was the control of external conditions in this experiment? The author states that "the temperature was uniformly about 74° F.". No mention, however, is made of the relative humidity of the air and the constancy of illumination. A brief indication of these would have carried conviction. It is needless to point out that a very rigorous control of external conditions is absolutely essential in a delicate work of this type. Is it possible that the accuracy of measurements of such minute growth-rates can be vitiated by the nutations of the coleoptile? This difficulty is met with particularly when measurements are made with an auxanometer or a kathetometer and is emphasised, for instance, by Du Buy[2] in his work on the growth of the coleoptile of *Avena sativa*.

Pusa,
February 1, 1943. R. D. ASANA.

1. *Curr. Sci.*, 1942, **11**, 443–444. 2. *Rec. Trav. bot. neerl.*, 1933, **30**, 858.

ASSAY OF INDIAN ERGOT

WITH the exception of ergot found on certain species of grasses near the Simla Hills,[1] medicinal ergot growing on rye has not been reported from India. Recently, Mr. K. M. Thomas of the Mycology Department, Agricultural Research Institute, Coimbatore, South India,[2] has successfully grown ergot on rye plots in the Nilgiri hills following the method originally advocated by Hynes,[3] and referred to in detail by Mukerji and Bose.[4] Through the courtesy of Dr. J. N. Ray, Director of Production (Drugs and Dressings), Office of the Director-General, Indian Medical Service, the Biochemical Standardisation Laboratory was afforded the opportunity of examining this specimen of ergot artificially grown for the first time in India. The medicinal importance of Ergot and shortage of the drug during war-time in India justify the publication of the analytical figures obtained.

1. *Botanical Examination*:

Length of sclerotia = 2 to 3 cm. Smallest size = 1 cm. Some sclerotia are cylindrical with a thick base and nearly pointed tip, others are markedly curved. Appearance—dark coloured hard structures, 4 to 5 mm. thick with a yellowish core.

The length of sclerotia imported from Europe varies from 1 to 3 cm. These are nearly cylindrical, slightly curved with longitudinal furrows and externally dark brown with a pinkish core.

Transverse section: The outer portion consists of small dark-coloured cells, the colour of which is changed to brownish red on the

addition of H_2SO_4. The rest of the sclerotium consists of nearly colourless, closely compacted, very small oval or rounded cells.

Imported sclerotia of ergot also shows more or less similar appearance.

Odour and taste, characteristic.

2. *Chemical Examination*:

(*a*) Assayed according to the method outlined in B.P. 1932 and Addendum 1936 to B.P. 1932,[5] the colour developed with a solution of dimethylamino-benzaldehyde being compared with the help of a Zeiss Pulfrich Photometer for accuracy of colour matching.

Found: Total Alkaloids of Ergot, 0·13014 per cent. (*i.e.*, 130·14 mg. per 100 gm.) [B.P. specification, 0·05 per cent. (*i.e.*, 50 mgm. per 100 gm.)].

(*b*) In view of the importance of the new water-soluble alkaloid of Ergot (Ergometrine, Moir[6]), the water-insoluble (Ergotoxine—Ergotamine group) and water-soluble (Ergometrine) alkaloids present in *Indian* ergot were separately estimated by the method of Hampshire and Page.[7]

Found: Total alkaloids (calculated as Ergotoxine) = 0·1213 per cent. (121·32 mg. per 100 gm.) Water insoluble alkaloids (calculated as Ergotoxine) = 0·1169 per cent. (116·9 mg. per 100 gm.). Water soluble alkaloids calculated as Ergometrine) = 0·0237 per cent. (2·37 mg. per 100 gm.).

3. *Pharmacological Examination*:

Broom and Clark method[8] of assay, with rabbit uterus (parous rabbit uterus dissected into strips of approximately equal length and thickness) and with ergotoxine ethanesulphonate (1 in 30,000) as *standard*, was used. The observations suggest that the content of ergotoxine in the liquid extract prepared from Indian ergot according to B.P. process would lie between 0·085 and 0·145 per cent., and that the mean of 0·115 per cent. would not probably be far from the true value of ergotoxine content in the liquid extract.

There is no suitable biological method for estimating the ergometrine content of ergot specimens. The method of Brown and Dale[9] could not be employed. The content of ergometrine could not, therefore, be biologically confirmed.

The analytical data clearly show that Nilgiri ergot satisfies all requirements laid down in the B.P. This conclusion is strengthened by several analyses of ergot sclerotia carried out previously in the B. S. Laboratory and elsewhere.[10] The total alkaloidal content of imported ergot was found in six assays to vary between 0·010 to 0·110 per cent. Swiss workers reported a much wider variation (in thirty assays) of total alkaloidal content of European ergot (fresh) between 0·000 to 0·200 per cent.

The opinion may, therefore, be expressed that ergot artificially produced in India on rye is of good quality with adequate total alkaloidal content and has developed both the water-insoluble (Ergotoxine group) and water-soluble (Ergometrine) alkaloids in suitable proportions for therapeutic utilisation. It is in certain respects better than many batches of imported ergot with comparatively poor alkaloidal contents.

Botanical study was conducted by Mr. A. B. Bose and part of the pharmacological study by Dr. N. K. Dutt and Dr. B. Chowdhury. Dr. I. B. Bose carried out the assays on imported ergot sclerotia when he was stationed at Calcutta.

Dr. Venkatachalam and Mr. Ratnagiriswaran[11] of the Research Unit, Medical College, Madras, carried out independently a chemical and biological assay of this ergot directly sent to them by Mr. Thomas. The results obtained by these workers, though slightly on the higher side, corroborate our finding in that the Nilgiri ergot is at least of the B.P. quality, if not better.

Biochemical Standardisation Laboratory,
Government of India,
Kasauli and Calcutta,
January 28, 1943.

B. MUKERJI.
N. K. DEY.

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ON THE PRE-SOWING TREATMENT AND PHASIC DEVELOPMENT

RECENTLY an interesting article on pre-sowing treatment and phasic development was published by Dr. Chinoy[1] which I have read with interest. In this connection I wish to place on record the results of pre-sowing treatment of the rice plants carried out in the Botanical Laboratory, Ravenshaw College, Cuttack, for the last four years, the preliminary report of the results and seed treatment having already been detailed in the Progress Reports of Orissa Rice Research Scheme, 1937-38[2] and 1940-41.[3] It was therein reported that the treated plants flowered 8 to 10 days earlier than the controls.

The seed treatment adopted by Dr. Chinoy is on the same line as detailed by the author for the rice plants, and is as follows:—Seeds are soaked in water for 24 hours, when the basal portion of the lemma at the midrib becomes opaque, indicating the swelling of the embryo. The seeds are then taken out, air-dried for 6-8 hours, placed in an electric oven at 40° C. to 42° C. for 24 hours; after which they are taken out and sowed along with the controls. Even at the seedling stage the treated and the untreated seedlings manifested differences in drought resistance. An observation recorded on 17-11-42 is as follows:—By 10-30 a.m. large number of plants had wilted

in the control and only two to three among the treated plants. By 2 p.m., all the plants in both the treated and untreated had wilted. Five hundred c.c. of water were added to each of the pots. After five minutes 32 plants in the control and 11 in the treated still remained wilted. After fifty minutes all the plants in the treated had recovered while 6 plants in the controls still remained wilted.

The seedlings were transplanted in tin pots containing 4 kilograms of soil, to which 1,000 c.c. of water was added to keep the soil at 25 per cent. level of moisture content. The treated and control seedlings were transplanted in 25 pots of each. After the plants were established the surface of the pots was covered with cellophane paper with a central hole of 1 sq. inch for the plant. These 25 plants in each were divided into three series of 8, 8 and 9, with 8, 10 and 12 days interval of watering respectively. At the time of watering the pots were weighed and the loss of weight was recouped to bring the pots to 25 per cent. level of moisture content again. This procedure was continued till the time of harvest when the whole plant was cut excluding the roots. Water requirement of each plant was calculated by dividing the total quantity of water transpired by the weight of the dry matter. The results of the experiments in 1941 winter season were sent to the statistical laboratory, Calcutta, where they were analysed and the results are given below.

TABLE I

Total Water Transpired (in grams)

Crop: Paddy

Intervals of watering	Control		Treated		Control — Treated	Fisher's "t"	D.F.
	N	Mean	N	Mean			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
8 days	6	4960	8	5176	−216	239	35
10 ,,	7	7563	8	6898	665	·767	,,
12 ,,	5	6999	7	6859	140	·143	,,

S.E. = 1675. G.M. = 6393. S.E. per cent. = 26·2.

TABLE II

Dry Weight of Tops (in grams)

Intervals of watering	Control		Treated		Control — treated	Fisher's "t"	D.F.
	N	Mean	N	Mean			
(1)	(2)	(3)	(4)	(5)	6	(7)	(8)
8 days	6	2·67	8	3·83	−1·16	1·378	35
10 ,,	7	4·74	8	5·84	−1·10	1·364	,,
12 ,,	5	4·81	7	5·36	0·55	0·603	,,

S.E. = 1·558. G.M. = 4·59. S.E. per cent. = 33·9.

TABLE III

Yield of Grain (in grams)

Intervals of watering	Control		Treated		Control — treated	Fisher's "t"	D.F.
	N	Mean	N	Mean			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
8 days	6	·595	8	1·066	−·471	2·197	25
10 ,,	7	·736	8	·722	·014	·068	,,

S.E. = ·3968. G.M. = 0·791. S.E. per cent. = 50·0.

TABLE IV

Water Requirement

Intervals of watering	Control		Treated		Control — treated	Fisher's "t"	D.F.
	N	Mean	N	Mean			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
8 days	6	1526·7	8	1093·9	427·8*	6·000	35
10 ,,	7	1389·9	8	1089·5	300·4*	4·398	,,
12 ,,	5	1455·0	7	1282·6	172·4*	2·230	,,

S.E. = 132·0. G.M. = 1284·1. S.E. per cent = 10·3.

The following conclusions may be drawn from the statistical analysis:—

1. The water requirement for treated plants is significantly less than for the controlled plants for each interval of watering (Table IV).
2. The yield of grain for treated plants is significantly greater than for the control plants when the interval of watering is eight days (Table III).
3. Treated plants have more dry weight of tops than control plants but the difference is not statistically significant (Table II). Similar observation was also made in a field experiment tried with treated and untreated seed.

Botanical Laboratory,
Ravenshaw College,
Cuttack, P. PARIJA.
December 12, 1942.

1. *Curr. Sci.*, **11**, No. 10. 2. *Orissa Rice Research Scheme Progress Report*, **1937–38**. 3. *Ibid.*, **1940–41.**

EVIDENCE OF DISTRIBUTION OF FISHES REGARDING RISE IN SALINITY OF THE RIVER HOOGHLY

IN his recent work on "Deltaic Formations, with special reference to the hydrographic processes of the Ganges and the Brahmaputra", Strickland[1] has referred to two diverging views regarding the salinity of the waters of the River Hooghly. From figures of salinity of the river water at Cossipore Electric Power Station, Calcutta, from 1925 to 1937, supplied

by Mr. Kilford of the Calcutta Port Commission and quoted by Strickland, it is clear that the salinity is rising. Mr. Oag of the Calcutta Port Commission is, however, of the opinion that Mr. Kilford's figures indicate an ephemeral phenomenon only and after an historical study of old records he has concluded that the Hooghly has improved during the past 100 years.

From a study of the distribution of fishes found in the River Hooghly above Calcutta, Prashad[2], and Hora and Nair[3] have shown that the salinity of the water of the River Hooghly is gradually increasing and this is explained by Prashad by the fact that "the flow of fresh water downstream is unable to counteract the influence of the tides to the same extent as it was before the present deterioration of the river".

The occurrence in the River Hooghly of bottom fishes of marine or estuarine genera, such as *Platycephalus*, *Cynoglossus*, *Pseudorhombus*, *Odontamblyopus*, *Pseudapocryptes* and *Apocryptes*, far inland above tidal influence is to my mind a clear indication of the penetration of a bottom wedge of brackish water, especially during the hot and dry months. It may be pointed out in this connection that in recent years hydrobiological work in estuaries in America and the East Indies has shown that a large or a deep river entering the sea has a bottom layer of salt water, which extends upstream in a wedge of diminishing thickness until it is entirely replaced by fresh water. As the fresh water is much lighter than sea water, it forms a layer over the salt water, but the layer gets gradually thinner as the force of the flow of the river water is lessened by the effect of tides, currents, etc. It is also dependent on the volume and force of the fresh water brought down from above.

Special attention may here be invited to the distribution of the following species of salt-water fishes found in the River Hooghly far above Calcutta.

Platycephalus indicus (Linnæus) was not known to Hamilton[4], who made extensive collections in the River Hooghly, both at Calcutta and lower down, from 1798 to 1814; it was found as high up as Uchitpur. Several specimens were also collected at Pulta and Chandernagore, and at the present day the species appear to be not uncommon in this part of the river. Francis Day[5], who made extensive collections of fish in India from about 1860 to 1876, gave the distribution of *P. indicus* (= *P. insidiator*) as "Red Sea, East Coast of Africa, seas of India to the Malay Archipelago and beyond". I have not seen it recorded in literature from fresh waters, except by Mori[6], who lists it among the fresh-water fishes of the Yangtse-Kiang, a large river with a big estuary where conditions of salinity are probably similar to those in the River Hooghly.

Sphæroides oblongus (Bloch) was found at Pulta. This fish was not found by Hamilton in the Ganges and Day gave its distribution as "Seas of India to the Malay Archipelago, China, Japan and the South Seas". It was not recorded by Day from Calcutta.

Cynoglossus lingua Hamilton, of which many young specimens were found as high up as Maltipur (the species is not uncommon at Pulta, about 17 miles above Calcutta), was described by Hamilton in 1822. He observed that:

"By the English of Calcutta it is called a Sole, and equals in quality and size this most valuable fish; but in that city it is not very common, as *it is found only in the estuaries that are strongly impregnated with salt.*" (Italics are mine.)

According to Day, this species is found in the "Seas and estuaries of India", but he figured a specimen from Calcutta. Presumably he purchased it from the market, where estuarine fishes are brought for sale.

Pseudapocryptes lanceolatus (Bloch and Schneider), *Apocryptes bato* (Hamilton) and *Odontamblyopus rubicundus* (Hamilton) were found by Hamilton in the estuaries of the Ganges when he was stationed at Baruipur in the 24-Parganas. According to Day, these species were found at Calcutta in his time, but the past history of the river (see Banerjee's *History and Hydraulics of the River System near Calcutta*) indicates that about 1880 it showed signs of severe deterioration, and presumably in the years preceding this abnormal condition the advancing salt water may have influenced the migration of the estuarine forms to the higher reaches of the river. During my survey of the fish fauna of the River Hooghly in March 1937, *Apocryptes bato* was found as high up as Maltipur, while a few specimens of *O. rubicundus* were taken at Chandernagore. All the three species are now fairly common at Pulta.

The species enumerated above are mostly bottom-living forms and, though they are now capable of tolerating fresh waters, there is hardly any doubt that their original migration upward must have been facilitated by a bottom wedge of salt water. In this connection it seems pertinent to remark that during March-April at the low tide period at several places above the town of Hooghly the water of the river is usually a foot or so deep. This silting up of the bed is probably the result of lack of any fresh-water current from above, which, in the case of other rivers, in whch hydrobiological investigations have been carried out, has been found to have a considerable influence on the distribution of the fauna in the estuaries lower down. The upper section of the Hooghly river seems to be almost like a stationary pool, and in consequence very large number of pond-dwelling forms are found in that portion of the river.

Department of Fisheries, Bengal,
1, Decdar St., Calcutta,
January 30, 1943. S. L. Hora.

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1. Strickland, C., *Deltaic Formations*, Calcutta, 1940, 110-13. 2. Prashad, B., *Rep. Zool. Surv. Ind. for 1935 to 1938*, 1938, viii-ix. 3. Hora, S. L., and Nair, K. K., *Rec. Ind. Mus.*, 1940, **42**, 558-59. 4. Hamilton, F., *An Account of the Fishes found in the River Ganges and its Branches*, Edinburgh, 1822, 1-404. 5. Day, F., *The Fishes of India*, London, 1876, 277. 6. Mori, T., *Studies on the Geographical Distribution of Fresh-water Fishes in Eastern Asia*, Chosen, 1936.

REVIEWS

Advances in Enzymology, Vol. II. Edited by F. F. Nord and C. H. Werkman. (Interscience Publishers, Inc., New York), 1942. Pp. viii + 374. Price $ 5.50.

This series has entered its second year and the contents of the present volume are as fundamentally important and interesting as the contributions published in the first volume. The scope of the series, as envisaged in the introduction to the series, has been extended to cover the fields of vitamins and hormones; an article on Vitamin K by its discoverer and an informative review on the adrenal cortical hormones have been included.

Twelve contributions comprise the volume and first of these on bacterial viruses concludes with a highly suggestive discussion of the host-virus relationships. The author has advanced several speculative hypotheses on this fascinating subject which includes the pregnant suggestion that the synthesis of new virus demands not only the utilisation of the storage products of the cell but also the short-lived intermediate products of metabolism. The author adds, "The virus makes use of the metabolic machinery of the cell for its own needs. The oxidation-reduction cycle and the phosphorylation cycle of some cell metabolite may directly be involved. Such a study will require the analysis of the growth of the host and of virus in the presence of a variety of substrates and inhibitors under aerobic and unaerobic conditions. In the opinion of the reviewer, the problem of the autocatalytic synthesis in the cell may be approached in this manner with promise of success".

The kinetics of hydrolytic enzymes and their bearing on methods of measuring enzyme activity, discussed by Van Slyke will prove useful to workers in the field of enzyme chemistry. Bergman has classified the specific interrelationships among the large number of proteodastic enzymes, in the light of his own work. Enzymatic properties of peptidases are reviewed by Johnson and Barger. Special mention should be made of the exceedingly valuable review on the heterotropic assimilation of carbon dioxide contributed by the very same authors who were the first to describe this phenomenon as an experimentally accomplished concept. Those interested in this latest and spectacular advance of biochemistry can, with profit, turn to this stimulating and comprehensive review. Other reviews in the volume include articles on diamin-oxidase—an enzyme not extensively studied, respiratory and fermentative enzyme mechanisms associated with Aspergilli, cellulose decomposition by micro-organisms and a unified hypothesis of the reciprocal integration of carbohydrate and fat metabolism. A highly speculative and laboured review on the chemistry of tea fermentation is also to be found in the volume.

This volume represents an even greater improvement over the first of the series; the publishers deserve all praise not only for the beautiful get-up of the volume but also for their venturesome and praiseworthy enterprise.

Temperature Control. By A. J. Ansley. (Chapman and Hall, Ltd., London), 1942. Pp. viii + 126. Price 13*sh*. 6*d*.

The regulation and control of temperature in any system is an important and frequently needed laboratory technique, the fundamental principles and practice of which are to be found in many texts on experimental physical chemistry, in special monographs; and also scattered in several contributions on pure and applied sciences. Recently an impressive volume of contributions to a symposium on "Temperature—its Measurements and Control in Science and Industry" (covering 1375 pages) has been published by Messrs. Reinhold Publishing Corp., New York, and reviewed in *Current Science*, Vol. 10, p. 415. There is, however, still scope for a handy volume expounding the principles with complete practical details for a judiciously selected number of equipments for the control and regulation of temperatures as used in the laboratories and industries. The book under notice, though it purports to be one such volume, is however, a strange medley of useful but frequently extremely elementary informations, clothed in somewhat cumbrous and inadvertent wordings and of statements which are incorrect. Thus on page 5, regarding vapour pressure control, the author states that "it is superior to the direct expansion of a liquid method owing to the extensive range which can be obtained by increasing or decreasing the liquid charge contained in the sensitive phial or capsule"! Again he states, "The disadvantage of this type is that since vaporisation of the liquid is a straight line function, the differential of the control over a wide temperature range will vary considerably". The book contains many other similar statements. On page 9, in an elementary description of the potentiometric method of measurement of e.m.f. of thermo-couples, it is said that in the null position when the galvanometer G shows no deflection, the e.m.f. of the couple is equal to that of the cell F! The following sentence from page 82 is hard to beat: "The liquid whose *rotary* power is desired is contained in a glass *cylinder* placed horizontally between the relevant optical parts of the *refractometer*" (italics ours).

There are besides quite a few printers' errors and the figure 20 on page 36 is printed upside down. Although the publishers have not been sparing in their usual high standards of printing and production, the book needs drastic revision and correction. RAU.

A First Course in Algebraic Geometry. By B. B. Bagi, Government Officers' Colony, Dharwar, 1941. Pp. vi + 264. Price Rs. 2-12-0.

This book is written by Professor Bagi, a well-known author of several text-books in

mathematics. It has certain distinctive features of its own and is very useful to Intermediate students of our Universities and forms a good addition to college libraries.

K. V. I.

Fighting for What? By Sir John Orr, D.S.O., M.C., F.R.S. (Macmillan & Co., London), 1942. Pp. 89. 2*sh*. 6*d*. net.

Sir John Orr in this book faces the problem of post-war reconstruction with abundant hope and enthusiasm. He would not indeed accept the word "reconstruction", with its suggestion of a return to pre-war conditions. "The old order", he says, "is passing away. ... The world is in the throes of a new birth." The political system has collapsed, witness the occurrence of two world wars within twenty-five years. So has the economic system or lack of system, which underlies the political catastrophe. The advance of science makes it possible to produce more and more wealth with less labour, but in pre-war days the results were less evident in increasing prosperity than in restriction of output and widespread unemployment.

"The primary material essentials of life are (1) food and (2) shelter which includes a house, furniture, clothing and warmth. To these must be added (3) a job, which is a psychological necessity. ... If we are planning for human welfare we must put first things first and concentrate on food, houses and a job. Whatever obstacles prevent us from providing these necessities must be ruthlessly removed."

It is about first of these that Orr, as a distinguished worker in the field of nutrition, speaks with greatest assurance and authority. As a result of scientific research carried out during recent years, "optimum" dietary standards have been established, *i.e.*, the type of diet which is needed to produce good physical development and health in human beings is known. Statements of food requirements have been issued by various authoritative bodies, including the Technical Commission on Nutrition of the League of Nations, and all are in general agreement. These standards provide us with "a yardstick by which we can measure the extent to which diets in common use are adequate for health and estimate the amounts of a given foodstuff needed to bring the diet of a given population up to the standard for health". When the diets which population groups actually consume are investigated, it is found that only a proportion of the world's population consumes a diet which conforms with the ideal standard. This is true even in the United States and England in peace-time. In such countries as India under-nutrition and malnutrition are widespread. Orr quotes a recent dietary survey in Ceylon which showed that a third of the population does not get *enough* to eat. The proportion in India is about the same.

So far, so good. We may accept Orr's analysis of the situation as substantially correct. What is to be done about it? Orr outlines a post-war food policy for Great Britain, based on a National Food Board which in turn will control various Commodity Boards. "The National Board should be responsible for bringing up the national supplies of the main foodstuffs up to the level needed to provide sufficient for everybody and for arranging that sufficient would be available within the purchasing power of everybody. The Board should be voted the necessary funds to carry out these functions and the annual report of the Board would be discussed in Parliament at the time when the funds were voted." Increased demand for food will mean prosperity for the farmer. A world food policy must be drawn up by a supreme economic council, with an international financial organisation to control international trade in food. "Each nation will need to estimate the amount of each of the staple foodstuffs needed to feed its population, keeping in view the dietary habits of the people, and then decide which can be most profitably produced at home and which most profitably imported in exchange for exports which it can produce more easily than the food it needs to import."

Orr's statement of the *need* to face post-war problems boldly on an international scale and with the full resources of science is admirable, but in so short a book he has been able to sketch his constructive proposals only in outline. The science of nutrition deals with uncontroversial facts, drawn from scientific observation and experiment. It is far otherwise with economics. All suggestions for the reform of existing economic and political systems are of their very nature bitterly controversial. An author who enters this field has no body of ordered facts on which to draw. In any "History of Human Error" a prominent position would have to be given to ideas about political economy which have been accepted as axiomatic by intelligent and instructed men. "The marginal propensity to consume", "the principle of effective demand"—these and numerous other concepts of the economists doubtless mean something, but they do not seem of great help in constructing a better world. The ordinary man—and in this particular context Orr is an ordinary man—has reacted against the complicated arguments of the professors by getting hold of one simple idea. It is that the application of scientific methods in agriculture and industry now makes it possible for the world to produce an abundance of the necessities of life for all mankind. The necessary wealth can be produced, provided an efficient and equitable system of distribution can be evolved. While this idea is no doubt in many respects naive and—to use an overworked word—utopian, it has a great appeal to scientific workers who are impatient to close the gap between scientific knowledge and its application. But scores of thorny and tortuous obstacles—financial, social and psychological—lie between the goal and the grim realities of the existing world. How can the economics of abundance be reconciled with human nature, with national boundaries and tariffs, with legitimate profits, with the vast differences in industrial and

educational development which exist in the different countries of the world? One could readily add twenty more such questions.

Orr's book is in many respects stimulating and inspiring, particularly in its insistence that when the war has been won a great opportunity awaits mankind to plan its economic and political life on a sounder basis. It is by pointing out the absurdities and failures of the present systems and by clearly describing the ideal which scientific development makes theoretically possible rather than by elaborating concrete constructive proposals, that such minds as his can make their most useful contribution to post-war development.

W. R. A.

Report on the Fish and Fisheries of Lake Nyasa. By C. K. Ricardo Bertram, H. J. H. Borley and Ethelwyun Trevavas. (The Crown Agents for the Colonies, 4, Millbank, London), 1942. Pp. 181. Price 12/6.

This paper is the report of a Fishery Survey that was conducted on Lake Nyasa during 1939 in conjunction with the Nyasaland Nutrition Survey. The three authors of the report formed the members of the Survey. Lake Nyasa is the third largest of the African lakes and is 350 miles long and about 50 miles wide at its widest part. It occupies about a third of the whole of Nyasaland. During the Nutrition Survey by Dr. B. S. Platt it was realised that no economic or dietetic improvement for the people of Nyasaland could be planned without a programme for the rational exploitation of the natural resources of the Nyasa lake. As a result of this the fishery survey was undertaken.

The report embodies a detailed account of the fishes of the lake, their description, economic importance, distribution, methods of capture, size and feeding and breeding habits. Among important food fishes are the species of *Tilapia, Labeo, Barbus, Bagrus* and *Clarias.* A list of all the species with local names has been given in the order of economic importance. The condition of the various fisheries of the lake has been discussed. There are two European fishing stations working on the lake. A large portion of the fish from these fisheries is exported. At present fish in fresh condition is not available for the local population living more than about three miles away from the lake shore. According to the report, just a fraction of the local population living near about the shores of the lake, is engaged in fishing. Organised fishing throughout the year is not done. The existing methods of fishing and fish curing have been described. The appendices at the end of the report contain data regarding hydrographical readings, geographical distribution of fishes, catches from nets and traps, fishing in different seasons and localities, results of curing experiments, fishery regulations, etc. The report is well illustrated with figures and photographs of important fishes and fishing methods of the lake. Recommendations have been given for the enlargement and rational exploitation of the fisheries. Though valuable information about fishes, fishing methods and the fisheries of the lake has been recorded in the report, the survey cannot be regarded as complete since it had to be abruptly terminated on account of the commencement of war.

It is clear from the report that lake Nyasa is a vast and productive fishery resource. There is immense scope for its development. It may be suggested that the Government of Nyasaland would do very well to appoint a whole-time officer, well trained in fisheries work, to carry out the suggestions made in the survey report and to organise the development of the fisheries of the lake on sound scientific and technological basis.

B. S. B.

CENTENARIES

Robison, John (1778–1843)

JOHN ROBISON, a Scottish inventor, was born at Edinburgh, 11 June 1778. After leaving the University, he worked for a short time at cotton mills at Manchester and in 1802 he was appointed to a business house at Madras. From there, he entered the Nizam's Services and was chiefly employed in the furnishing of guns ammunition. He also laid out grounds for the Nizam on the English model. Having acquired a considerable fortune, he left India in 1815 and spent his later life in inventions and other scientific activities such as the secretaryship of the Royal Society of Edinburgh and the founding of Scottish Society of Arts.

He contributed more than seventy papers to scientific periodicals. His inventions were numerous and ingenious. From boring a canon to drilling a needle's eye, nothing was strange to him. He made a marble pendulum for the clock of the Royal Society of Edinburgh, as being less subject to variations due to temperature than metal. He was knighted in 1838. He was always enthusiastic in making known merit among talented artificers.

Robison died, 7 March 1843.

McCoy, Elijah (1843–1929)

ELIJAH McCOY, a Negro inventor, was born in Canada, 27 March 1843. He specialised in the automatic lubrication of machinery. He took more than forty patents, the first of which dates from 1872.

He was a pioneer in devising means for steadily supplying oil to machinery in intermittent drops from a cup, without the need for stopping a machine to oil it. His lubricating cup was in use for many years in the engines of railways and steamships and in factories.

McCoy died in an infirmary, 10 October 1929.

SCIENCE NOTES AND NEWS

Conservation of Wild Life in India.—In his annual address to the National Institute of Sciences of India delivered last January at Calcutta, the President, Dr. B. Prashad, dwelt on the urgent necessity and the measures imperatively needed for the conservation of wild life in India. He made the point that the genesis of this world problem was to be traced primarily to the increasing ascendency of man over his environment. It is only very recently, however, that the existence of the problem has been recognised and the conscience of the world quickened, specially as a result of the efforts of a number of international conferences. The formation and development of many of the world-famous National Parks and Game Sanctuaries have been influenced by the resolutions adopted at these conferences. In 1935, an All-India Conference was convened by the Government of India to review the position and provide protection for the flora and fauna in this country. This Conference laid special stress on the establishment of wild life sanctuaries and also on the need for educative propaganda. A beginning has been made in the establishment of such parks, notably in the U.P., Assam and Mysore. In the field of propaganda, although much pioneer work has been done by a few enthusiastic individuals and scientific bodies—conspicuously the Bombay Natural History Society—it is disappointing that the (only) Indian Journal devoted to this subject, *The Indian Wild Life*, has had to cease publication—temporarily it is to be hoped. In conclusion, Dr. Prashad stressed on the complexity of the problems involved in any scheme of wild life conservation. The conservation of soil, waterways, forests and grass lands is intimately, though not always obviously, bound up with the direct measures for the conservation of wild life. At present for want of data, most conservation programmes in India must of necessity be empirical. Meanwhile, wild life management must be planned on ecological and biological data available, with the aim of preserving not merely a few species of game but the conservation of animal and plant life in general.

The Dictionary of Raw Materials of India.—The Council of Scientific and Industrial Research has arranged for the compilation and publication of a Dictionary of Raw Materials of India. An Editorial Staff working under the direction of an Advisory Committee has been appointed. In spite of the present unsettled conditions a most earnest endeavour will be made to collect all available knowledge regarding the raw materials of the country. An appeal is made to everyone who has any information of value on any aspect of the subject to communicate the same to Dr. B. L. Manjunath, Chief Editor, Dictionary of Raw Materials, 20, Pusa Road, Karol Bagh, New Delhi. Such assistance will be duly acknowledged in the text.

Use of Substitutes for Steel in Reinforced Concrete.—Of various substitutes for steel reinforcement so far tested, bamboo appears to be the most promising for India. Its ultimate tensile strength has been given by various authorities as between 14,000 and 30,000 lbs. per sq. inch, compressive strength between 5,000 and 10,000 lbs. per sq. inch, and Young's Modulus between 1,000,000 and 2,500,000 lbs. per sq. inch. It can be used whole but is recommended cut into thin strips. Placed cross-wise in the form of a mesh, it is suitable for light reinforcement preventing temperature cracks in concrete roads, floor slabs and canal linings. In China, bamboos are required to be three years old before use. In Italy bamboos are given a waterproof coat before use to prevent swelling due to absorption of water. As it is relatively new as a reinforcement no data exist on its durability, but this need not debar its use in purely temporary structures.

Literature on the efficient design of reinforced concrete structures, rigid frames, higher working stresses, pre-stressing and the use of substitutes, is available on loan from the Secretary, Central Board of Irrigation.

Botanical Society of Bengal.—The Seventh Annual General Meeting of the Botanical Society of Bengal was held on Saturday, the 6th March 1943, at 4 p.m., at the Botanical Laboratory, Calcutta University, with Professor S. P. Agharkar, President of the Society, in the chair. The Secretary, in presenting the annual report for the year under review, showed an all-round progress of the Society in spite of the present emergent situation. In delivering his presidential address on the "Practical Applications of Ecology", Professor Agharkar stressed the importance of the environmental conditions as a factor in the successful cultivation of the agricultural crops and forest plants. It was pointed out that only ecological principles would enable us to obtain larger supplies of food and other forest products required for the successful conduct of the war.

The following were duly elected as Office-bearers for the session 1943-44:—

President: Mr. S. N. Bal. *Vice-Presidents*: Prof. S. P. Agharkar, Prof. S. C. Mahalanobis, Dr. K. P. Biswas, Prof. S. R. Bose and Prof. J. C. Sengupta. *Treasurer*: Mr. I. Banerji. *Councillors*: Mr. K. G. Banerji, Mr. E. A. R. Banerji, Dr. P. N. Bhaduri, Dr. N. K. Chatterji, Dr. K. T. Jacob, Miss S. Meyer, Dr. S. K. Mukherji, Mr. P. N. Nandi and Dr. S. R. Sengupta. *Hon. Secretaries*: Dr. B. C. Kundu and Dr. J. K. Chaudhuri.

The Horticultural Society of India.—This Society is formed with the object of advancing the cause of horticulture in India by organising efforts to create facilities for horticultural work in the country and to safeguard the interests of Indian horticulture, by establishing a Central Institution and Provincial Organisa-

tions. It will also publish a horticultural journal and hold general and local meetings with a view to diffusing horticultural knowledge among horticultural workers and the public and facilitating contact between members. Membership is open to all persons interested in any field of horticulture. For further information please write to the Secretary. The following are the personnel of the Executive Committee elected for 1943:—

President: Dr. G. S. Cheema.

Vice-Presidents: (1) Sardar Bahadur Sarda Lal Singh; (2) Mr. Percy Lancaster.

Treasurer: Mr. K. C. Naik.

Secretary: Dr. P. K. Sen.

Councillors: Mr. M. Mustafa (Quetta), Rao Bahadur H. C. Javaraya (Bangalore), Khan M. Aslam Khan (Peshawar), Mr. S. S. Bhatt (Baroda), Mr. M. R. Fotidar (Srinagar), Mr. W. Hayes (Allahabad), Dr. S. Hedayetullah (Dacca), Dr. N. K. Nandi (Shillong), Dr. V. S. Badami (Cuttack), Mr. R. S. Singh (Lucknow), Mr. M. L. Garg (Sahranpur) and Mr. D. T. Desai (Bombay).

The Secretary, Advisory Panel on Drugs and Medicines, Biochemical Standardisation Laboratory (Government of India), writes to us as follows:—

You are perhaps aware that the Government of India have for sometime been considering the question of revising the present method of control of imports of drugs and medicines from abroad to ensure that only the most suitable medicines and in the most suitable quantities are imported under the Import Trade Control Scheme. With this object, they have set up an "Advisory Panel on Drugs and Medicines" with the following terms of reference:—

"To advise the Government of India as to which drugs and medicines, other than those the formulas of which are included in the Official Pharmacopœias of the exporting countries, it is essential to import into India from abroad.

(Note.—The term 'Official Pharmacopœias' includes the British Pharmacopœia, the British Pharmaceutical Codex, the United States Pharmacopœia, and the National Formulary of the United States of America.)

The Panel met at New Delhi on 10th December 1942, and decided to issue a set of Questionnaire to appropriate parties in order to collect representative opinion regarding the drugs and medicines which should be imported into India.

The Panel desires to have the views of all persons, associations or bodies interested in this question with respect to the points mentioned in the terms of reference. It will feel grateful if you will kindly go through the questionnaire and send your replies, under the groups suggested, as early as possible. It is not contemplated that all questions are to be answered by each and every one to whom the questionnaire is being issued. It would be helpful if answers are given against those questions only which are in your field."

Those interested may obtain copies of the questionnaire and related information by communicating with the Secretary, Advisory Panel on Drugs and Medicines, 110, Chittaranjan Avenue, Calcutta.

A CORRECTION

Note entitled "On the Manufacture of Glandular Products in India" (*This Journal*, 1943, p. 61). Dr. U. P. Basu, in a letter dated February 25, 1943, writes:—

"It seems there are two omissions in the manuscript. ..... So, please *insert* the word 'grams' after 100 in the 23rd line, and the expression 'grams of the' after 100 in the 27th line. Thus the yield in question has always been considered in terms of the weight of glands used."

MAGNETIC NOTES

Magnetic conditions during January 1943 were slightly less disturbed than in the previous month. There were 18 *quiet* days, 11 days of *slight* disturbance and 2 of *moderate* disturbance as against 14 quiet days, 16 days of slight disturbance and 1 of moderate disturbance during the same month last year.

The quietest day during January 1943 was the 14th, while the 17th was the day of the largest disturbance.

The individual days were classified as below.

Quiet days	Disturbed days	
	Slight	Moderate
2, 5–11, 13–15, 19, 23–25, 29–31.	1, 3, 4, 12, 16, 18, 21, 22, 26–28.	17, 20.

Two moderate storms were recorded in January 1943 as against none in January 1942.

The mean character figure for the month of January 1943 was 0·48 as against 0·58 for the same month last year.

Magnetic conditions during February 1943 were more disturbed than in the previous month. There were 5 *quiet* days, 22 days of *slight* disturbance and 1 of *moderate* disturbance as against 12 quiet days, 12 days of slight disturbance and 4 of moderate disturbance during the same month last year.

The quietest day during February 1943 was the 28th, while 17th was the day of largest disturbance.

The individual days were classified as shown below:—

Quiet Days	Disturbed days	
	Slight	Moderate
10, 12, 21, 22, 28.	1 to 9, 11, 13 to 16, 18 to 20, 23 to 27.	17

One moderate storm was recorded in February 1943, while none were recorded during the same month last year.

The mean character figure for the month of February 1943 was 0·86 as against 0·71 for February 1942.

M. V. SIVARAMAKRISHNAN.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory, Bombay, during the month of January 1943, there were three of slight intensity. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin I.S.T.	Epicentral distance from Bombay	Co-ordinates of epicentre (tentative)	Depth of focus
		H. M.	(Miles)		(Miles)
12	Slight	02 20	1390	Lat. 39°. 5 N., Long. 69° .5 E., near Samarkhand.	..
12	Slight	15 35	1390	Lat. 39°. 5 N., Long. 69° 5 E., near Samarkhand.	..
27	Slight	09 15	5890	..	..

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory, Bombay, during the month of February 1943, there were four of slight, one of moderate and one of great intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin I.S.T.	Epicentral distance from Bombay	Co-ordinates of epicentre (tentative)	Depth of focus	Remarks
		H. M.	(Miles)		(Miles)	
6	Slight	04 46	570	..	..	..
6	Slight	09 07	560	..	..	..
9	Slight	03 36	1250	..	..	Epicentral region probably in Assam.
22	Great	15 51	9750	..	..	Epicentral region located in Southern Mexico. Felt in Mexico.
24	Slight	05 50	1910	..	..	..
28	Moderate	19 24	1290	Lat. 39°N., Long. 69°·5 E., to the north of the Hindu Kush mountains.	160	..

We acknowledge with thanks receipt of the following:—

"Indian Journal of Agricultural Science," Vol. 12, No. 6.

"Journal of the Indian Botanical Society," Vol. 22, No. 1.

"Journal of Chemical Physics," Vol. 10, No. 11.

"Journal of the Indian Chemical Society,"

"Allahabad Farmer," Vol. 16, No. 1.

Vol. 19. Nos. 11 and 12.

"Transactions of the Faraday Society," Vol. 38, Pts. 11 and 12.

"Indian Forester," Vol. 69, No. 3.

"Bulletin of the Indian Central Jute Committee," Vol. 5, No. 11.

"Indian Medical Gazette," Vol. 78, No. 2.

"Journal of Research," Vol. 29, No. 2.

"Science," Vol. 96, No. 2497.

"Science and Culture," Vol. 8, No. 9.

BOOKS

The Application of Absorption Spectra to the Study of Vitamins, Hormones and Co-enzymes. By R. A. Morton. (Adam Hilger, Ltd., London), 1942. Pp. 226. Price 28*sh.*

Prakasha Lekhan Sastrantheel Auscharyaim. By K. A. Damle. (The Author, Kala Bhavan, Baroda), 1943. Pp. 156. Price Rs. 2.

Theoretical Organic Chemistry. By Julius B. Cohen. (Macmillan & Co., London), 1942. Pp. vii + 622. Price 10*sh.*

Mineralogy, Petrology and Economic Geology. Tables for the use of Geologists, Prospectors and Mining Engineers. By N. L. Sharma. Indian Society of Engineers, Calcutta), 1942. Pp. 22. Price Rs. 3-8-0.

The Falling Rupee, A Study in War Finance and Inflation. By C. N. Vakil. (The Author, University of Bombay, Bombay), 1943. Pp. iii + 38. Re. 1-4-0.

School and College Libraries. By S. R. Ranganathan. (The Secretary, Madras Library Association, Madras), 1942. Pp. 432.

266-43—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri M Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science", Bangalore

CURRENT SCIENCE

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SCIENTIFIC UTILISATION OF INDIAN OIL-SEEDS

OIL-SEEDS form a valuable part of the annually recurring agricultural wealth of this country. Out of an estimated area of about 300 million acres of land under actual cultivation, forming roughly 25 per cent. of the geographical area of the Indian Empire, about 60 million acres are under oil-seed crops. Besides, the 90 million acres of Indian forests also yield, as minor forest produce, commercial quantities of important oil-seeds. The approximate acreage and annual output of the more abundant oil-seeds are given below:—

Oil-seed	Acreage in millions of acres	Output in millions of tons
Cotton	25·0	2·0
Groundnut	10·0	3·3
Mustard and rape group	7·0	1·0
Linseed	5·0	0·5
Gingelly	5·0	0·6
Castor	2·0	0·2
Cocoanut	1·4	1·4
Poppy	0·5	0·2

The less abundant, but nonetheless valuable commercial oil-seeds comprise Mowra, Nigerseed, Safflower, Kokum, Domba, Dhupa, Chaulmogra, Neem, Ritha, Cashew, Honge, Kusum, Hemp and many others.

The present annual output from all these sources may be roughly taken as 10 million tons, which may be approximately valued at 100 crores of rupees. One of the first questions which strikes a rational publicist in relation to this large annual output is how far this agricultural wealth has been harnessed to satisfy the demands of internal consumption or of a policy of sound national economic prosperity. At any rate, the proper utilisation of this precious raw material in the best interests of Indian agriculturists and their professional requirements is a responsibility which no enlightened government or patriotic businessman can shirk.

A rational plan of utilisation of oil-seeds should commence with a systematic assessment of the scientific value and industrial potentiality of the three main components of every commercially important Indian oil-seed, *viz.*, (1) the shells and husks, (2) the oils and fats derived from the kernels, and (3) the residual oil-cakes. Of these, systematic analyses have so far been mainly undertaken on the fatty oils prepared from the seeds or seed-kernels.

As many as 1,000 species of oil-seeds belonging to about 125 Natural orders of plants have been analysed for the content and characteristic properties of their oils and a few valuable guiding principles discovered, showing remarkable similarities

in the scientific and industrial potentialities of oils belonging to the same natural order of plants. It is needless for the purpose of the present article to describe in detail either the different modes of extraction of oils from oil-seeds or the variety of treatments and processes to which oils are subjected in the various industries connected with their multifarious utilisations at the present time. One need only peruse the following list of their industrial uses:—

(1) Refined salad and edible oils including hydrogenated vegetable ghees, (2) Toilet, Textile and Liquid Soaps including Turkeyred Oils, (3) Illuminating Oils, Candles and Liquid Fuels, (4) Glycerine and Explosives, (5) Paints, Varnishes, Lacquerware, and Plastics including rubber substitutes, (6) Shoe and Leather-dressing Greases and Polishes, (7) Simple and Compound Lubricants, (8) Linoleum and Waterproof Fabrics, (9) Medicinal Oils and Pharmaceutical Compositions, (10) Various Fine Chemicals including valuable Synthetic Perfumes.

This list is gradually expanding with the advancing scientific knowledge concerning fatty oils. Though a given oil may not be adaptable to every one of the above uses, it is possible by suitable treatment with physical and chemical processes, to utilise the product for several of the purposes. It is exactly in this direction that there is immense need and scope for a systematic investigation of the industrial possibilities of every indigenous fatty oil of commercial importance.

Compared to available scientific knowledge concerning fatty oils, that relating to oil-cakes is deplorably meagre. The industrial and scientific value of oil-cakes is in no way inferior to that of the related fatty oils. In some respects, their importance as edible foods, as cattle fodder, and as fertilisers is incomparably greater than that of the oils themselves. Many of them are in the first instance capable of yielding by suitable methods of extraction a variety of valuable fatty, glucosidic, alkaloidal, and resinous drugs and detergents, without affecting their further utility as rich sources of vegetable proteins, carbohydrates and mineral constituents. A systematic scientific investigation of our oil-cakes has unlimited scope and will amply repay the time and energy spent on it.

The position regarding the scientific knowledge of shells and husks of oil-seeds is even more precarious than that of oil-cakes. Sufficient is, however, known regarding a few of these, *e.g.*, cotton-seed hulls, cocoanut and cashew shells to warrant the prediction that many of these, on suitable treatment, may prove to be rich sources of phenols, of furfuraldehyde and of kindred chemicals, which are essential ingredients for a "synthetic plastics industry". The ashes of many of these hulls and shells are rich sources of valuable potash and phosphates. It is needless to stress the importance of a systematic research into their scientific and industrial potentialities. At present they are either used as cheap fuel or as doubtful fodder.

Properly utilised, the raw oil-seeds estimated at 100 crores of rupees can easily be made to yield a variety of finished products worth at least 500 crores of rupees. The above forecast is based on a review of several years of research experience with indigenous oil-seeds and related products, and it should convince our leading statesmen and industrialists that there is an urgent need in India to-day for one or more co-ordinated Provincial Institutes devoted exclusively to fundamental and systematic investigations into the scientific and industrial value of indigenous oil-seed products. Provision will have to be made for a periodical demonstration and dissemination of the resulting knowledge among our industrially gifted artisans through the media of local vernaculars.

Without such a concentrated endeavour and organisation on our part, our agricultural activities will only maintain our countrymen as permanent "Hewers of Wood and Drawers of Water", leaving the more remunerative aspects of the industrial utilisation of our raw materials in the hands of the more enlightened and actively organised industrialists of the other countries. One therefore trusts that our business magnates and administrators will rise equal to the occasion and enable Indian scientists to contribute their best for our national industrial prosperity.

SIR S. S. BHATNAGAR, Kt., O.B.E., D.Sc., F.Inst.P., F.I.C., F.R.S.

FELLOW-SCIENTISTS in India and chemists in particular will learn with pardonable pride and sincere satisfaction the happy news of Sir S. S. Bhatnagar's

recent election to the Fellowship of the Royal Society of London. He has the distinction of being the first Indian Chemist to receive this signal honour. Readers of *Current Science* are fully aware of his numerous fundamental contributions in the field of colloid, magneto- and photo-chemistry. He and his pupils have in no small measure been responsible for the establishment of a number of schools of physico-chemical research now flourishing in several parts of India. More recently his activities in the field of applied chemistry both as Professor of the Panjab University and as Director, Board of Scientific and Industrial Research, have been crowned with striking successes and all these have received due and grateful appreciation not only by the Government of India but also by industrialists, fellow-workers, and learned societies.

Sir S. S. Bhatnagar was born in 1895 and had his education in Lahore, London and Berlin. On several occasions he has represented India at many of the international congresses of pure and applied sciences. His dynamic, inspiring and genial personality, have won for him a wide circle of disciples, friends and admirers.

Sir S. S. Bhatnagar has been one of the most enthusiastic and whole-hearted supporters of *Current Science* since its very inception and has actively encouraged and guided it in a number of ways. We consider it a great privilege to offer him our heartiest felicitations on the occasion of his election and wish him many years of active and greater service in advancing the cause of science and industry.

DR. H. B. DUNNICLIFF, C.I.E., M.A. (CANTAB.), Sc.D. (DUBLIN), F.I.C., I.E.S.

DR. HORACE BARRATT DUNNICLIFF, Chief Chemist, Central Revenues Chemical Laboratory, whose retirement from service was recently announced, has been a leading personality of the chemical profession in India during the past three decades. After a distinguished university career in London and Cambridge, he arrived in India in 1908 as Professor of Science in the M.A.O College, Aligarh. In 1914 he was appointed to the I.E.S. and seconded as Professor of Chemistry in the Khalsa College, Amritsar. His services were transferred to the Government College, Lahore, in 1917, and as Professor of Chemistry, and sometime Principal of the College, Dr. Dunnicliff found opportunities not only to carry out original investigations in the fields of inorganic and analytical chemistry but also to organise and develop the Central Revenues Chemical Service in this country. The organisation

of this service is perhaps his most outstanding achievement and marks the fruition of his unremitting efforts to obtain the recognition of the Government for his profession.

Early in his career, Dr. Dunnicliff recognised the need for organising the chemical profession in this country and for placing it on a lasting foundation. In 1918 he was appointed Works' Chemist in the Cordite Factory, Aruvankadu, under the Indian Munition Board and at the time of leaving

it in 1921, he was in charge of the laboratory and with characteristic ability, he directed a large number of chemical investigations of great value to the munition production. At the instance of the Government of India, Dr. Dunnicliff prepared in 1928, a comprehensive scheme for testing laboratories at the major port towns of India and Burma and when it was decided by the Government to give effect to his scheme in 1929, Dr. Dunnicliff reverted to the Government College, Lahore, and with the approval of the Punjab Government, established the chemical laboratory of the Central Board of Revenue in the Government College, Lahore. The work of this laboratory, which included the whole field of Revenue Chemistry, assumed enormous proportions and necessitated the organisation of a laboratory exclusively devoted to this work. The Central Revenues Chemical Service was instituted in 1937 at his instance and 14 permanent and temporary gazetted officers and a number of chemical assistants are now engaged in customs work under this service in the laboratories at Calcutta, Bombay, Madras, Karachi, Ghazipur, Sambhar Lake and New Delhi. The Central Revenues Chemical Laboratory was established in 1939 and Dr. Dunnicliff assumed Scientific Control of Central excise work as Chief Chemist in 1939. Dr. Dunnicliff's name is intimately associated with this big organization and he will be ever remembered in this country as the founder of the Central Revenues Chemical Service and Laboratory.

Dr. Dunnicliff has to his credit a large number of original research papers in inorganic and analytical chemistry. His recent work on the by-products of the Salt Industry has attracted world-wide attention. In 1939, he was awarded the C.I.E. in recognition of his work for the Central and Punjab Governments. He is Chairman of the Naturally Occurring Salts Committee of the Board of Scientific and Industrial Research, and member of the Drugs Advisory Board and the Drugs Supply Committee of the Government of India. His association with *Current Science* dates from the time of its inception and the *Journal* has found in him an able guide and an enthusiastic supporter. Dr. Dunnicliff is an accomplished musician and has taken active part in a number of social and sports activities, particularly in amateur theatricals. We wish him a long and happy life in his retirement.

SIR M. VISVESVARAYA ON APPLIED RESEARCH IN RELATION TO INDUSTRIAL DEVELOPMENT AND POST-WAR RECONSTRUCTION

ADDRESSING the Sixth Annual Meeting of the Court of the Indian Institute of Science, Sir M. Visvesvaraya, the President of the Court, re-emphasised the fact that the Institute was founded in order that its activities might be devoted to securing for India the material benefits expected to follow from the close association of scientific research with the industries of the country. He added. "Such was also the primary object for which this Court was established. I trust it is permissible to hope that in future the new Court will devote two or three days of its time at each annual session for enquiring into, and discussing, the affairs of the Institute and for reviewing the progress made in science and research both at this Institute and in other institutions in the country. By doing so, they will be not only setting a healthy precedent but will also be serving the interests of science and industry in the country as a whole."

Reviewing the progress achieved during the preceding quinquennium, Sir M. Visvesvaraya remarked, "a casual examination of the annual reports of the previous years will disclose the fact that industrial research which was the main purpose for which the Institute was established had been allowed to fall into background. How this came about is explained in my previous addresses. A Joint-Committee of the Council and the Court was constituted in March 1940 to suggest measures to give industrial research its proper place in the scheme of things, and some of the suggestions recommended by that Committee are now being slowly given effect to. It has been found difficult to make rapid changes because the funds available are limited and it has not been practicable to divert the money already earmarked for other useful objects. Steps are being taken to follow a consistent policy in future and to strengthen the industrial research side of the work until at least half the regular expenditure of the Institute is separately devoted to it.

"The Quinquennial Reviewing Committee which functioned in 1936 was the last of its kind. The Committee due in 1941 was not appointed on account of the war. I believe there is no necessity for appointing any more reviewing committees. A better plan in future would be to depute one or two professors to foreign countries as often as funds permit to study world progress in the subjects in which training is given in the Institute. The reviewing committees did useful work when the Institute was still young but the men who conceived the idea and shaped the original plan could not have intended that the Institute should remain in leading strings for all time.

"The budget estimates of income and expenditure which were presented to the Court at its first meeting in March 1938-39 were likely to amount to Rs. 6,00,354 and Rs. 6,05,868, respectively. The corresponding figures of income and expenditure in the revised estimates for the year 1942-43 are Rs. 9,55,017 and Rs. 11,30,105. The opening balance in the former budget stood at Rs. 5,34,373 and in the latter Rs. 4,70,413. The reduction of about Rs. 64,000 was due to the increased cost of apparatus and materials in war time and also to the extra sums that had to be spent on applied research in order to obviate the cutting down of other useful collateral activities that had sprung up. Several new schemes have been initiated, income has grown, and expenditure on work done during the lifetime of the last Court has increased by more than 80 per cent. All this is a distinct sign of prudent administration and progress."

He then referred to the higher types of technological instruction which was being recently imparted at the Institute. "The first of these developments was a course in chemical engineering, started in 1940-41, in which systematic instruction is being imparted. Equipment of considerable value required for this section has already been secured, and the syllabus is being constantly improved and brought up to date. This development was necessary to give preliminary training to students coming fresh from the laboratories of theoretical sciences before they embark on industrial research. I understand that the course has been quite popular with the freshmen admitted to the several departments of Chemistry,

"A second development is the course newly started from January 1943 for post-graduate training in Aeronautical Engineering. This is the first scheme of its kind in India. The Government of India have sanctioned a capital grant of Rs. 1,25,000 for the construction of a Wind Tunnel and the accessory laboratories, and a recurring grant of Rs. 41,800 for the salary of the staff and working expenses. These grants have been supplemented by a capital grant of Rs. 1 lakh from the funds of the Institute for equipping the laboratories. The aeronautical engineering industry has a great future before it and there is every prospect that the graduates who have chosen this post-graduate course will not lack profitable employment.

"Our thanks are due to Sir John Higgins, Mr. W. D. Pawley and Mr. L. C. McCarty for the valuable work they have rendered to the Institute in the planning and equipment for this course. Sir John Higgins, the Chairman of the Board of Directors of the Hindustan Aircraft, Limited, in a message to the Factory *Gazette* for February 1943 gives a very hopeful account of the progress of the local factory. He is of opinion that the work of the employees of the Company has now a scope far beyond the original aims set before them and he goes on to add: 'I look forward confidently to the time when this factory will compare favourably with the best aircraft factories in America or England.'

"It may be of interest to mention in this connection that Mr. W. D. Pawley, the American expert of the Bangalore Aircraft Company, has offered a scholarship of $3,000 a year for four years to students of this Institute, tenable at an American institution for higher studies in aeronautical engineering.".

Continuing he said, "another important departure from routine developments is the projected establishment of a chair of Applied Mechanics and Automobile Engineering together with the nucleus of a research laboratory for the work of the professor to be appointed. This is due to the munificence of the Government of Mysore who have given the Institute a capital grant of Rs. 1 lakh and a recurring grant of Rs. 15,000. Provision is made in the budget for 1943-44 for starting work on this course.

"I brought to notice last year that the Institute did not possess the facilities of staff necessary to help large-scale or key industries. It is equipped to a certain extent for work in chemical industries but even in that sphere facilities for large-scale chemical industries are lacking. Both the Pope Committee and the Sewell Committee have recommended that the creation of a mechanical engineering laboratory should constitute the very first item in the Institute. The war that is going on is a mechanical engineers' war and if this Institute is to be of material help for war effort or for safeguarding the defences of the country, a department of Applied Mechanics should be started, Applied Research should be materially strengthened, and a research workshop added to form an integral part of both."

Discussing the present deficiencies and wants of the Institute, Sir M. Visvesvaraya said, "This Institute has not yet cultivated sufficiently closer relations with heavy industries so far, and no attempt has been made to establish Research Fellowships for heavy industries.

"Information and data pertaining to the leading key industries are being collected in the office of the Institute but the progress seems to be slow. It will be slow until an officer of the grade of an Assistant Professor is made definitely responsible for developing this activity.

"In last year's session of this Court, I pleaded for the setting up of a large engineering workshop and laboratory in order that the Institute may be able to handle satisfactorily many of the important problems that arise from time to time in mechanical engineering, electrical engineering, and heavy chemical industries. This will require substantial grants both capital and recurring; say, a capital grant of Rs. 10 lakhs and a recurring one of Rs. 2 lakhs. It is hoped that the Government of India will find the necessary funds. Help in this respect may be also available from the Indian States and the leading industrialists in the country. Not until adequate provision is made for the efficient engineering workshop and laboratory, can the Institute be said to have become a real home of industrial research.

"It is hoped that the policies and aims of the Institute will be clearly defined and a plan of work for the next five years determined by the Governing Council under the

advice of the Joint-Committee already referred to.

"Oftentimes, work in the field of pure research is of a routine character. This type of pure research is better left to institutions which are not so well equipped as this Institute is. Work in this Institute should be concentrated, mainly, though not altogether, on two or three specific objects, namely, technological instruction of the highest grades, research in heavy industries whether newly projected or already in operation, and theoretical research of a fundamental character.

"Since science is advancing very fast, closer co-ordination of duties between the members of the staff and orderly development of work on a plan in all the departments are *sine qua non.*

"If all the above-named deficiencies and wants are to receive prompt attention and the original intentions of the Founder faithfully given effect to, the best course would be to appoint a Committee of three members including the Director to watch the interests of the Institute on behalf of the Governing Council and keep the latter correctly posted in matters which it should know in order to exercise effective supervision and control. Each member of this Committee, other than the Director, may hold office for a couple of years and one of the two members may be elected every year jointly by the Council and the Court. The two members should be paid an honorarium or fee to ensure disciplined adherence to regulations on their part. This Committee of three should be of the nature of a specialised staff charged with the duty of keeping a watch on the progress of science and research both within and outside the country, of keeping an eye at the same time on the day-to-day needs of the Institute, and of continuously submitting proposals and programmes for improvement and reform as required. Since the Council meets only three times a year, a change of this kind seems absolutely necessary in order to do away with the hesitancies, delays and mistakes of the past. This is one of the principal measures needed to make the Institute a self-governing and self-improving institution."

In the course of the address he outlined the activities of the Board of Scientific and Industrial Research. He said: "On 2nd April 1940, the Government of India announced the establishment of the present Board of Scientific and Industrial Research. The creation of this Board was a happy move. It was expected that thereafter there would be a satisfactory co-ordination of work between the pure science research worker, the industrial scientist and the industrialists throughout the country. At commencement the services of research workers were utilised only for war work and the industries entrusted to the Board were all of a minor character. I understand that in recent months research in, and manufacture of, heavy chemicals are being encouraged, but the co-ordination of research work which is going on in all parts of the country, and which was considered important three years ago, has not yet been brought about.

"The Director of Scientific and Industrial Research and some of the members of the Board are scientists of acknowledged capacity and initiative. Some of the Committees appointed seem to have taken a serious view of their responsibilities and passed resolutions in favour of practical action in connection with the following among other industries:—

Internal combustion engines, Fuel research, Metallurgical industries, Dye-stuffs, Glass and refractory materials, and Manufacture of Industrial plants.

"Government have so far not shown much inclination to encourage the establishment of any of these industries. On the other hand it is understood that instructions have been issued to the Committees to confine their attention to the technical aspects of their problems and not to express views regarding administrative support or action, such as, protection, subsidies, etc., needed to establish the industries.

"I understand that another important resolution has been passed by the Council of Scientific and Industrial Research recommending the establishment of four research laboratories on an all-India basis, namely, a national chemical laboratory, a national physical laboratory, a fuel research laboratory and a metallurgical laboratory. It is hoped that preparations will be set on foot and necessary funds provided to give effect to this resolution.

"The latest move by the Council of Scientific and Industrial Research is the compilation and publication of a Dictionary of Raw Materials of India, embodying all

available knowledge of such materials. This is doubtless a satisfactory step, although a more urgent compilation, and a more useful one, needed is the collection and compilation of industrial statistics. In the absence of statistical measurement, it is feared Government themselves have no precise knowledge of the true industrial situation in the country."

Concluding Sir M. Visvesvaraya added, "The provision newly made for technological instruction of the higher grades is a notable event in the history of the Institute. Industrial research is also making some progress but it is yet far from what it should be. It is hoped the demand for more rapid progress will be recognised and that adequate provision will be made therefor in the proposed five-year plan which is at present under the active consideration of the Council.

"As regards research in India as a whole, it is satisfactory to learn that the Council of Scientific and Industrial Research has done some work for the war. But the co-ordination of research activities in all parts of the country which was to be one of its principal functions has not received much attention. At first only small industries and minor chemicals were allowed to be handled; latterly, however, heavy chemicals are also coming into favour. Discoveries and inventions are opening up a New Era of Engineering but there is no sign that research in relation to heavy engineering industries is making any progress at all in India outside the purely military establishments.

"I have had occasion from another platform to bring to notice the restrictions and limitations to which heavy industries have been subjected in India as compared with the phenomenal developments that have taken place in countries like Canada and Australia during this war. Till recently research was also treated in the same restrictive spirit. We have seen that several important recommendations made by the committees of the Council of Scientific and Industrial Research in favour of heavy industries, like the internal combustion engine, have not been accepted or even noted by Government. It cannot be said that an industry to manufacture internal combustion engines is not a vital necessity in any country or that it is not needed in India. I understand, however, that private establishments are attempting its manufacture with some success.

"It must be recognised that many industrialists and tradesmen have profited by the business done in textiles, raw and semi-raw materials and other war supplies, but it is a recognised economic axiom that *production of goods and services for war do not contribute to a country's economic welfare.*

"There is too much secrecy; no intelligent exposition of policies is available particularly in regard to industries. No official in high position ever gives a comprehensive interpretation of the views of Government, what they propose to do and why their policies and procedure are so different from those followed in any progressive country or even in the self-governing dominions of the British Commonwealth. There is no directory for war work or for civilian industries. Whatever attempts are made are fragmentary. The Governments of countries like Australia, Belgium, Russia and Czecho-Slovakia have set up offices in India to carry on their propaganda in this country. They issue News-Sheets regularly to acquaint Indians with what they are doing in their respective countries, whereas we do not get to know what our Government are doing in our own country. No stock-taking is done here, no review is attempted, of the industrial and economic affairs of the 390 millions of the population of India.

"As regards post-war reconstruction, although a beginning was announced and a Committee and Sub-Committees were appointed so far back as October 1941, no reports of those Committees have seen the light. What work the Committees did, whether they did any work at all is not stated. When the Committees began work, industries were excluded from their purview. All these are unusual practices under any Government. Such trends discourage enterprise and even preparations for post-war work. The appointment of a new set of Committees for post-war reconstruction has been announced within the past few days but that is also of the traditional type. No clear statement is made of the aims, or economic policies Government have in view.

"Contrast this attitude with these two statements picked out at random from the latest News-Sheet—*Astral News* for March 1943—just published in Calcutta:

Mr. Makin, Munitions Minister, said 'that Australian industry had been revolutionised to provide the maximum war effort.'

Dr. H. V. Evatt, another Minister, stated: 'Post-war reconstruction like the war task will consist in assuring that the country's economic resources are fully employed. They must be directed primarily for purposes which is Australia's obligation to achieve: namely, economic security and rising standards for all ..... Preparations in this respect will not retard but assist the war effort.'

"I am not pointing to any casual mistakes or omissions which in times of crisis like this are inevitable, but am referring to policies which seem deliberate and which threaten to cause permanent injury to the interests of our vast Indian population.

"I have had to refer to industries on this occasion because the main object of this Institute is to promote industries by means of research and there is a close interdependence between industries and research. It is needless to state that industrial research will have no value or importance if industries themselves are neglected or starved. Since at the present time, Government have taken control of almost every activity in the country, they owe a duty to the public to explain their policies and justify their inaction in respect of these three developments, namely, industries, industrial research for peace-time needs, and post-war reconstruction—as compared with what is happening under other Governments in the British Commonwealth. In the absence of such a statement, the future which India has to face, when the time for post-war reconstruction arrives, will be viewed by many thinking persons in this country with anxiety and apprehension."

DAIRY INDUSTRY AND ITS FUTURE

BY

NOSHIR N. DASTUR

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THE value of annual contribution of the bovine population to Indian economic wealth has been assessed at a colossal figure of one thousand crores of rupees. Of these, at least one-third is due directly to milk and milk products. Cattle maintenance is thus of great importance to India. It supplies not only a vast deficiency in our nutritional requirements but it is closely connected with the national economy. In spite of its magnitude, the present state of the dairy industry in India is rather sad. It is still steeped in orthodox sentiments, no attempt being made to fit in with the changing times and conditions. It is one of the most unorganised industries of the country and is carried out on individualistic basis. It is only a fortunate coincidence that the Indian populace is subconsciously aware of the nutritional importance of milk and its products.

In the past, on many an occasion human-made catastrophes have proved blessings in disguise. For example, it required the last Great War to teach the English farmers the benefits of properly organising their dairy industry and since then the development has been tremendous. In most of our urban centres, the situation is almost parallel to that existing in England at the time and considering the high prices the farm products fetch at present due to the war, it is to be hoped that this will provide a suitable opportunity for organising the dairy industry of this country on which a wider structure could be built later.

The prime function of the dairy industry is to produce enough milk to satisfy the needs of the country. The present production can at least be increased six-fold to achieve this end. This increase in milk market should no doubt bring in its train a better living standard for those engaged in this industry. Increase in production of milk is closely linked up with the number of the cattle population. India is in a paradoxical position that it has more cattle than it needs. India possesses about a third of the total cattle population of the world, yet the annual output of milk is hardly

12 per cent. of the whole. The average production of her animals is nearly one-fifth of those in New Zealand and one-eighth of those in Denmark. For milk production, food and right type of food, has to be provided to these animals. The present conditions in India do not permit of this maintenance of such a large number of stock. Unless this simple fact is realised, the dairy industry cannot make any progress. To-day India possesses about 100 million acres of land classified as "waste generally unsuitable for cultivation". There is no doubt that with the return of better times serious attempts will be made to utilise at least a part of this waste for growing food crops. The other logical solution is to dispose off a substantial portion of the present unthrifty stock. Their existence only means maintaining two half-starved animals where one should suffice. This subject is at present bound up with sentiment and it is also the bottle-neck which progressive forces in the country should try to break.

Before a nation-wide culling programme could be undertaken a simple system of recording the performance of each animal is essential. On this depends a rational distribution of the available foodstuffs and breeding of better generations. There is no doubt that by better selection, the average yield of our stock could be considerably raised. India depends on buffaloes to produce about 60 per cent. of her milk output. Yet at present there is far too little attention paid to the development of this class of milch animals. There are societies working in purely buffalo breeding tracts, which go out of their way to improve the milch qualities of poor-yielding cows, maintained mainly for draft purposes. The same energy and money spent in right directions can produce infinitely better results.

The greatest incentive to the production and improvement in the quality of milk and milk products is a guaranteed price. From the experience of other countries it becomes abundantly clear that unless a guaranteed price is allowed to producers, a large bulk of the profits is absorbed by the middleman who is little interested in rural conditions. In a big country like India, such measures are no doubt always difficult to be put in practice but with a little propaganda and organisation it is not impossible of achievement. At present, in the absence of such a scheme things sometimes go to ridiculous ends. For example, in most of the bazars, at least two types of ghee are sold, one for eating and the other for cooking purposes. There is usually a difference of at least 50 per cent. in the quality of the two. A section of the consuming public that cannot possibly afford to pay the price of genuine ghee likes to believe in this differentiation. It is, however, surprising how some of our health authorities also connive at this state of affairs.

One of the greatest handicaps in the successful development of the rural dairy industry on commercial basis is the lack of proper means of transport. Unless the villagers are well organised on co-operative basis the most profitable disposal of milk will always remain beyond the means of individual producers. It is possible that in the near future it will be realised that every village can have more and better milk and better health by maintaining a village co-operative dairy. For commercial exploitation of milk, quick transport of milk between the village and urban centres is an absolute necessity. Lack of proper transport compels the villagers to dispose off their milk by converting it into less remunerative products.

As in all other walks of life, the need for co-operative organisations cannot be over-emphasised. Production of milk, economically and in a reasonably clean state is an intricate process, starting from the production of right type of fodder to the disposal of the milk. Probably a small farmer never thinks about these details but the results of this *laissez-faire* policy are before our eyes. It is essential that every village or a group of villages, should learn the need for rearing their animals and producing their milk on a co-operative basis. After a preliminary experimental period, the producers will soon realise that they get a better value for their produce, their animals thrive better and the consumer slowly regains confidence in the quality supplied.

Before the desired quantity of milk can be produced in this country and utilised in the right way a little amount of education is also necessary. The farmer must be taught not to rely on straw alone as a food for his cattle. Application of existing knowledge for better conserving and producing good quality of feeding-stuff is

necessary. To do this he must also realise that every animal in his charge looks to a little corner in his field for its well-being.

At present the consuming public is inclined to lay stress on consumption of ghee much beyond what can be expected in return by way of nutrition. The remaining part of the milk is probably of greater nutritional value. If by spending the same money better nutrients can be bought they should learn to do it.

The economic importance of the dairy industry even in its present decadent state, as mentioned before, is enormous. One of its striking drawbacks is the total lack of interest shown in investigating the causes for many of the difficulties it encounters and in taking the help of modern scientific technic to overcome them. No doubt every ghee packer of importance maintains a room for housing a refractometer and one or two such other apparatus but that is mainly with the object of crossing the legal hurdle. One result of this policy is apparent. The Indian consumer is slowly losing confidence in the genuineness of the products of his own land and is prepared to pay fancy prices for imported articles. It is a tribute to other countries that they take pains to study the Indian requirements carefully and evolve technique to suit that demand. For example, a small import of ghee has already started. In course of time, if the warning is not taken, this is likely to oust a considerable proportion of the indigenous product. If the dairy industry is to advance and thrive, it must harness scientific knowledge to its needs.

Concluding, it may be stated that for the future development of the dairy industry a beginning has to be made from primary stages. Maintenance of just enough animals that can be properly fed, production of better quality of feeding-stuffs, co-operative dairy organisations, organised marketing and scientific research are a few points to be borne in mind, if it is desired to see commercial exploitation of milk a reality.

NATIONAL ACADEMY OF PEIPING

THE British Scientific Mission in China have just forwarded to us a little pamphlet, issued by the National Academy of Peiping, giving an account of the progress of the scientific activities under its auspices in war-time China, during the period 1937-42. The following is an *in extenso* extract of the report which will deeply interest fellow-scientists in this country and in other parts of the world.

"In accordance with an act passed by the Executive Yuan of the National Government, the National Academy of Peiping was established on September 9th, 1929, in Peiping, with the sole purpose of carrying out scientific researches and bringing about their applications. At its foundation, the Academy consisted of nine separate research institutes, namely, the Institutes of Physics, Radium, Chemistry, Materia Medica, Physiology, Zoology, Botany, Geology and Historical Studies and Archæology, and it used to have a staff of more than 200 members, including research professors, assistant research professors, senior and junior assistants and technicians, in addition to about thirty Chinese and foreign correspondent members. Contributions of all branches of work have been published in various languages, scattered throughout almost all the principal scientific journals of the world.

At the outbreak of the present war with Japan, Peiping was immediately taken over by the invaders; and we were then forced to suspend or relinquish our studies. However, in the midst of confusion and distress we succeeded in transferring a portion of the books and equipment of each of our institutes to the South and to places of safety. And, what was even more fortunate, within a few months after the war had reached a state of stabilisation, the Academy was able to resume the larger part of its work in the hinterland city of Kunming in the Province of Yunnan, where it has continued to be in existence up to the present moment. One can now imagine the danger and trouble we experienced in getting through areas of intensive military operations and lines of blockade, on the way from Peiping to Kunming, a distance of more than 2,000 miles by land and sea.

Furthermore, with a great quantity of material on hand, tremendous difficulty was naturally encountered in arranging for transportation, when all means of communication were in a state of disorder.

In spite of the hardships arising from the lack of the necessary equipment, shortage of funds and the constant menace to our personal safety, the work of the Academy is still in progress, to an extent far beyond the most sanguine expectations. Our activities have been vigorously pushed even under the most difficult conditions. Our interest and belief in science do not suffer the slightest diminution. Before going on to the work completed or being done in our institutes during the last five years, which will amply testify the above statements, a few words on the general situation of the Academy as a whole following a period of internal readjustment to adapt itself to the present environment, may be added here.

The National Academy of Peiping, still with its nine institutes, has now a smaller staff of 120 members. The major portion of our funds comes from the Government and amounts to $620,000 annually *plus* a variable monthly addition used to compensate the ever-rising cost of living under which our colleagues and their families must live. Naturally, we have an exceedingly hard time in managing to stretch this money to cover all of our expenditures, although we are also receiving financial aids from the Sino-American, Sino-British and Sino-French Foundation Funds. Regarding our policy in general, we can say that the greater portion of our research activities tends to be practical and economically important to meet the immediate needs of the nation. Our publications, which in former years amounted to nearly fifty kinds of bulletins, journals, memoirs, books and maps, *plus* 800 papers and reports, are still in progress, but on a very much reduced scale owing to the lack of efficient means of printing.

The following will serve to summarize our research work within the last five years in the different institutes. We are rather encouraged to catch a glimpse of the types of researches performed by ourselves since the Japanese invasion and to give our friends some idea of what the scientific workers of China are doing while the nation is being overrun by a catastrophic war.

1. Institute of Physics

To comply with our general policy, the Institute of Physics whose studies were chiefly in photography, spectroscopy, piezoelectricity and geophysics, has recently more and more inclined to attack practical problems that confront us in industry and national defence.

With its spectroscopic equipment, a laboratory of spectrum analysis has been immediately set up to meet the need of the just-beginning metallurgical industry in this country.

In the course of the war, numerous radio stations both fixed and movable have been established, but almost all of them are of quite small power. The wave interference between these stations would be troublesome, if they were not crystal-controlled. The Institute has stabilised more than one thousand transmitters with its quartz oscillators made in our laboratories and thereby it has certainly rendered a service to radio communication in China to-day.

Besides the work mentioned above, the Institute has confined its efforts mainly to the development of applied optics and geophysical prospecting.

When we were computing optical systems and designing optical instruments at Peiping, we keenly felt the need of optical instruments both in times of peace and of war. It was, therefore, decided to devote some of our members to the problems of applied optics and to set up a small optical shop in Kunming. For this purpose optical machinery had to be built, testing instruments to be designed, and craftsmen to be trained. After three years' painstaking work, we have arrived at a state of being able to produce most of the optical parts in good quality.

Optical parts like achromats, prisms and flats have been abundantly supplied to various institutions for educational and research purposes. Microscopes for the general usage of university students are being made in this shop according to the instructions of the Ministry of Education, and two hundreds of them are nearly completed.

In geophysics the establishment of a gravity map of China and the precise determination of longitudes and latitudes had been our two main undertakings. Since our removal to Kunming, although we continued the gravity determinations throughout the province of Yunnan to the borders

of Burma and Indo-China and redetermined the longitude and latitude of Kunming, the attention of our geophysicists, however, has been directed to our mineral resources, and their methods have been immediately put into application.

Our work in geophysical prospecting was mainly the study of metallic ore deposits. Up to the present, five different mining districts have been thoroughly examined by our geophysical field parties employing chiefly magnetic and electrical apparatus. The N.R.C. (National Resources Commission) I-Men Iron Mine was the first one surveyed, and this took us six months of field and office work. Then came the An-Ning Iron Mine, the Kuchiu tin mine, the Lu-Tien lead-silver mine, and lastly the Chaotung lignite field. All of these were successively subjected to geophysical investigation.

These studies have been carried out upon the request of the respective mining organizations whose interest and enthusiasm in geophysical methods are very encouraging. The results have not only greatly altered the concepts of the geologists and mining engineers as to the extent and economic value of these deposits, but also numerous facts and experiences arising from them have opened the door to improvements in the methods of geophysical prospecting. These results are thus also of academic interest.

Co-operating with the Geological Survey of China, we have organized a committee on geophysical work, which publishes all the contributions from the geophysical investigators of the country.

2. Institute of Radium

The Institute of Radium consists of three laboratories, that of chemistry, radioactivity and X-rays. In the two first a great number of Chinese minerals were examined chemically and radio-actively. Protactinium was much studied and its branching ratio redetermined with counters. A detailed study of the absorption coefficients of β-rays especially from UX_2 and RaE revealed the important fact that they have neither a fixed nor a single value, but depend on the thickness of the absorber and the surrounding conditions of the source under measurement.

In our laboratory of X-rays, the work is mainly on crystal analysis. Some improvements on classical methods and techniques have been made. With an induction furnace, some alloys of tungsten and antimony were prepared, and X-ray studies of them are now in progress.

3. Institute of Chemistry

Like most of our other institutes, the Institute of Chemistry has been for the past five years, devoting a large portion of its efforts and time to problems of applied chemistry, in addition to pure chemical researches. Upon this Institute, however, the war seems to have exerted a greater pressure, for the simple reason that here we have to import a considerable amount of chemical reagents from abroad and these are consumed at a rate far beyond our power of replacement. Nevertheless, we have been rather successful in dealing with the situation and are able to carry out our various types of work as outlined below.

In the field of applied chemistry our investigations have been following at least four lines: all of these were problems in which the public was calling for immediate solutions. They are (1) Extraction of dyestuffs from local plants and their application to various textiles, (2) Preparation and manufacturing on a small scale of medicines, utilizing local raw materials, (3) Recovery of used engine oils, replacement of diesel oil by vegetable oil, and preparation of a gasoline substitute from molasses asd sawdust, (4) Miscellaneous experiments such as the analysis of water samples taken from various places in the vicinity of Kunming, the extraction of potash from different kinds of ashes, etc.

In view of the drastic shortage of gasoline, a mobile alcohol plant was brought into operation. Despite its simple design, it steadily produces 200 gallons of 95 per cent. alcohol per day. In co-operation with a soap factory, complete installation of a vacuum evaporating plant has been set up to produce glycerine from the wastes of soap-making.

Concerning pure chemical researches, our attention has been mainly centred on problems of organic chemistry. Topics under investigation, within the period of five years, have been (1) Syntheses of organic compounds related to vitamin K, (2) Molecular rearrangements of organic compounds, (3) Synthesis of rotenone derivatives.

4. Institute of Materia Medica

Research work in this Institute has been concentrated on investigations of Chinese drugs, such as Chinese ephedra, Mahuang, Chinease corrydalis, Pei-Mu, Hsi-Hsin, Mu-Fang-Chi, Shih-Chan-Chu, Yang-Chin-Hua, Kou-Wen, Ta-Ch'a-Yeh, etc. The active principles have been isolated, and their constituent properties as well as the pharmacological actions have been studied: Besides, the Institute also prepares some materials such as ephedrine, vitamin B_1, etc., on the commercial scale for clinical use.

5. Institute of Physiology

Researches of this Institute were heretofore confined to pure studies in experimental biology and physiology proper, while special emphasis was also laid on the physiological effects of various Chinese drugs. However, within the last five years, in addition to pure academic work, subjects capable of application in daily life have likewise been successfully investigated. In this connection investigations in the nutrition values of the food-stuffs used by the southwestern inhabitants, experiments on the treatment of Chicken's Cholera by sulfanilamide, as also of typhus by some Chinese medicine from the Pentsao, are of significance.

Problems of local importance are now under investigation, namely, studies on the types of Chinese drugs produced in Yunnan and on the basal metabolism of the Yunnanese people.

6. Institute of Zoology

Researches conducted in this Institute were formerly restricted to the study of seashore animals of China. However, since the removal of the Institute from Peiping to this inland city of Kunming, this same sort of work has had to be directed to the limnological fauna of Yunnan. Thus the fauna of the Kunming lake, of the Erh Hai, the Yang-Tsung-Hai and the Fu-Sian Lake naturally have become our most easily attainable material to be worked on.

To intensify such investigations, an experimental station for lacustral biological studies was started in 1939, under the joint auspices of the Institute and the Commissariat of Reconstruction of Yunnan. Such a station is the first of its kind in China and, in spite of its very brief history, it has been able to make systematic studies of the principal fresh-water fauna of Yunnan, particularly the fishes of these inland lakes, their diseases and enemies, together with the chemical and physical properties of the lake waters. Besides aquatic animals, terrestrial animals like Reptilia and the spiders of Yunnan have also been collected and worked on.

7. Institute of Botany

Instead of going on with the studies on the plant-life of north, northeastern and northwestern China and its taxonomy, the Institute of Botany began, right after its removal to the interior, to do researches on problems of economic botany. Investigations in topics of agriculture and forestry had already been in progress for several years: topics such as, the distribution of forests, classification and disease of farming plants, and particularly experiments on cultivating drug plants, etc.

Under the joint sponsorship of the Institute and the National Northwestern Agricultural College, a special botanic survey was planned and organized with the aim to do researches on the plant-life of China's northwest, as also on their economic values. In 1940, a botanical garden was brought to completion, inside which our experiments have been performed. Botanical parties have been despatched to the various centres of botanic interest throughout the northwest, particularly, the surroundings of our great western mountain ranges. The material brought back has been abundant and valuable. The entire collection of plant specimens belonging to the Institute now numbers more than 60,000.

8. Institute of Geology

For over ten years our geological work has been going on under a co-operative scheme with the Geological Survey of China. Contributions to the science itself and to the geological work of this country have been countless and prominent, the most outstanding one being the discovery and identification of the fossil remains of the well-known *Sinanthropus Pekinensis* (the Peking Man) with its contemporary vertebrates excavated from the limestone caves at Chou-Kou-Tien near Peiping.

Since 1937, extensive field and laboratory studies have been in progress without any loss of their vigour on account of the war. Detailed mapping of mineral deposits occupies at least for the time being, the

major portion of our time spent in geological work, although stress is equally laid on paleontological studies and studies in other branches of the science, *e.g.*, the excavation and investigation of a complete fossil dinosaurs skeleton (*Lufengosaurus Hucenci* Young) from Lufeng Hsien, Yunnan.

As to our work in mineral deposits, *i.e.*, in economic geology, it can be possibly said that hardly any of the important discoveries and investigations made during the last five years in our western provinces have been carried out without the participation of our colleagues.

With a large accumulation of dependable geographical material on hand, the Institute has also revised completely the map of China for general use, and thousands of the new map are now in circulation among the public.

9. INSTITUTE OF HISTORICAL STUDIES AND ARCHÆOLOGY

In recent years the work of the Institute of Historical Studies and Archæology consists of mainly three items, the studies of literary materials in ancient Chinese history; the classification of archæological materials excavated at Pao-Ki-Hsien, Shensi, several years ago, and the collection of historical materials dealing with the inhabitants in the border zones of China.

In 1933, upon the request of the Shensi Provincial Government, there was appointed a committee which in 1934 started an excavation at Tow-Ki-Tai, a ruined site of Pao-Ki-Hsien in Shensi Province, and by 1937 materials of historical significance obtained were the remains of many human dwelling places in the Stone Age, also relics of ancient city walls and of more than one hundred tombs belonging to various ancient periods. With regard to these materials the first of a proposed series of publications, "Studies of Li-Tripods Excavated at Tow-Ki-Tai" by Mr. Su Ping-Ki, has just gone to press; while the report of the excavation is now under compilation.

Regarding the studies of literary materials in ancient Chinese history several important works have been completed within the last three years. They are (1) "The Legendary Period in Chinese Ancient History", a book of seven chapters (in press) by Mr. Hsu Ping-Tchang, being the investigation based upon ancient legends of the Chinese history from Huang-Ti to the Middle Shang Dynasty; (2) "Tsun-Ko-Tsin-Sze-Hwei Tien", by Mr. Hsu Tao-Ling (the name index for the holders of the degree "Tsin-Sze" during the various Chinese dynasties), being a compilation of the historical materials for the last one thousand years.

Papers in relation to all other investigations can be found in our publication "Collected Papers of Historical Studies".

PROFESSOR ALEXANDER SILVERMAN, of the University of Pittsburgh, stated in an address at the Franklin Institute, Philadelphia, on December 16 that glass is proving one of the most versatile of all war materials. It has taken over jobs formerly monopolized by such diverse materials as steel, silk and cork. It functions very much like steel in bullet-proof windshields and turrets on airplanes; glass sutures are replacing silk and gut in certain surgical uses, and a new material, bubble-filled masses of glass foam, has replaced cork in much new heat insulation. This glass foam promises to take up cork's job in life preservers also, for it is practically as light as cork and even more resistant to waterlogging. Unlike air-inflated rubber floats, it is indifferent to puncture; if a bullet passes through it, only the cells in the immediate path are destroyed, and the block floats serenely on. In addition to these more or less novel uses, glass serves the war effort in a hundred of its long-established and more conventional forms, all the way from medicine bottles and factory windows to accurately ground lenses for telescopes, range-finders and periscopes and carefully coloured photographic filters.

(*Science-Supplement*, Dec. 25, 1942.)

LETTERS TO THE EDITOR

A NOTE ON THE PROBLEM OF k SAMPLES

A FAMILIAR problem in analytic statistics is to test the hypothesis whether k samples of sizes $n_1, n_2, \cdots, n_k$ have been drawn at random from the same unknown Normal Universe. In general, the k samples could have come from k different Normal Universes with means $\mu_1, \mu_2, \cdots, \mu_k$ and standard deviations $\sigma_1, \sigma_2, \cdots, \sigma_k$. The most common hypothesis tested is whether, given that $\sigma_1 = \sigma_2 = \cdots = \sigma_k = \sigma$, we can infer that $\mu_1 = \mu_2 = \cdots = \mu_k = \mu$, where σ and μ are unknown. The 'statistic' which has been considered appropriate for this problem is Fisher's Ratio of Variances, say V_b/V_w where

$$V_b = \sum_1^k n_i (\bar{x}_i - \bar{x})^2 / (k-1);$$

$$V_w = \sum_{i:1}^{k} \sum_{j:1}^{n_i} (x_{ij} - \bar{x}_i)^2 / (N-k);$$

$$N = \sum_1^k (n_i) \text{ and } \bar{x} = \sum_1^k (n_i \bar{x}_i) / N.$$

When there are only two samples ($k = 2$) we have

$$V_b / V_w = (\bar{x}_1 - \bar{x}_2)^2 / V_w \left(\frac{1}{n_1} + \frac{1}{n_2}\right)$$

which is distributed like "Student's" t^2 with $n_1 + n_2 - 2$ degrees of freedom. Fisher has also shown that when $k > 2$, we may compare the differences between any two sample means, by means of the same t-test, calculating V_w from within all the k samples, with $N-k$ degrees of freedom. Thus

$$t^2_{ij} = (\bar{x}_i = \bar{x}_j)^2 / V_w \left(\frac{1}{n_i} + \frac{1}{n_j}\right).$$

The total number of such tests of pair comparisons is $k(k-1)/2$. Thus the single hypothesis $\mu_1 = \mu_2 = \cdots \mu_k$ is being broken up into $k(k-1)/2$ separate tests involving the hypothesis $\mu_i = \mu_j$ for the particular pair of ith and jth samples.

The following identity is easy to prove

$$\Sigma\, n_i (\bar{x}_i - \bar{x})^2 \equiv \Sigma\, \Sigma\, n_i n_j (\bar{x}_i - \bar{x}_j)^2 / N.$$

Therefore

$$V_b/V_w = \Sigma\Sigma\, n_i n_j (\bar{x}_i - \bar{x}_j)^2 / N (k-1) V_w$$
$$= \Sigma\Sigma\, (n_i + n_j)\, t_{ij}^2 / \Sigma\Sigma\, n_i + n_j).$$

The ratio of variances is therefore only a weighted mean of the $k(k-1)/2$ different values of t^2. This result brings out clearly the connection between the two tests of significance.

It may be recalled that a paper by P. V. Krishna Iyer[1] and also certain notes he[2] and the author[3,4] published in this journal some

time ago dealt with the same problem of k samples. Mr. Krishna Iyer took the unweighted mean of all the values of t^2 and finding it different from the ratio of variances felt that the former would be the proper criterion for discriminating between the sample means. The form he obtained for the distribution of the unweighted mean of all the values of t^2 was found to be erroneous. In fact the true distribution does not come out in a suitable form for exact tests of significance. The relationship between the ratio of variances and the weighted mean of the different values of t^2, established above would indicate that there is no point in trying to develop a test based on the unweighted mean.

Statistical Laboratory, K. R. NAIR.
Presidency College,
Calcutta,
March 10, 1943.

1. P. V. Krishna Iyer, *Proc. Ind. Acad. Sci.*, 1937, **5**, 528. 2. —, *Curr. Sci.*, 1938, **6**, 392. 3. K. R. Nair, *Ibid.*, 1937, **6**, 290. 4. —, *Ibid.*, 1938, **7**, 21.

AN EXTENSION OF THE NEWTONIAN RELATION

$$\sum_{r=0}^{w-1} (-)^r a_r s_{w-r} + (-)^w w a_w = 0^*$$

THE relations given below may be considered as extensions of the Newtonian relation mentioned above :—

$$G(pq) = \sum_{m=1}^{p-1} \sum_{m=1}^{q-1} (-)^{s+m+2} a_{s+m} G(p-m, q-s) + q \sum_{m=1}^{p-1} (-)^{q+m+2} a_{q+m} G(p-m) + p \sum_{s=1}^{q-1} (-)^{p+s+2} a_{p+s} G(q-s) + \overline{p+q}\, (-)^{p+q+2} a_{p+q}.$$

$$G(p\,q\,r) = \sum_{t=1}^{p-1} \sum_{m=1}^{q-1} \sum_{s=1}^{r-1} (-)^{t+m+s+3} a_{t+m+s}.\ G(p-t, q-m, r-s) + r \sum_{t=1}^{p-1} \sum_{m=1}^{q-1} (-)^{r+m+t+3} a_{t+m+r}.\ G(p-t, q-m) + q \sum_{t=1}^{p-1} \sum_{s=1}^{r-1} (-)^{t+q+s+3} a_{t+q+s}.\ G(p-t, r-s) + p \sum_{m=1}^{q-1} \sum_{s=1}^{r-1} (-)^{p+m+s+3} a_{p+m+s}.\ G(q-m, r-s) + \overline{p+q} \sum_{s=1}^{r-1} (-)^{p+q+s+3} a_{p+q+s} G(r-s) + \overline{q+r} \sum_{t=1}^{p-1} (-)^{t+q+r+3} a_{t+q+r} G(p-t) + \overline{p+r} \sum_{m=1}^{q-1} (-)^{p+m+r+3} a_{p+m+r} G(q-m) + (-)^{p+q+r+3}\, 2\,!\ \overline{p+q+r}\, a_{p+q+r}.$$

It may be mentioned that when $p-t = q-m = r-s$, the coefficient of a_{t+m+s} will be $(-)^{t+m+s+3}\, 3\,!$, in place of $(-)^{t+m+s+3}$. Similarly when any two of the terms $p-t$, $q-m$ and $r-s$ are equal, the usual coefficient given above will have to be multiplied by 2!

Similar relation can be given for $G(p, p_2 \ldots p_s)$. For economy in space, the coefficient of a typical term alone is given.

$(\alpha-1)!\ \overline{p_k+p_l+p_m \cdots \alpha \text{ terms}}\ \Sigma\, \Sigma \ldots\ s-\alpha$ times $(-)^{p_k+p_l+p_m \cdots + \Sigma r_t + s}\, a_{p_k+p_l+p_m+ \cdots \Sigma r_t}$.

$G(p_1-r_1, p_2-r_2, \ldots p_{k-}-r_{k-1}, p_{k+1}-r_{k+1}, \ldots p_{l-1}-r_{l-1}, p_{l+1}-r_{l+1}, \ldots)$. As mentioned before, the coefficient will have to be multiplied by π_1', π_2', etc., if π_1', π_2', etc., terms of p_1-r_1, p_2-r_2, $\ldots p_s-r_s$ happen to be equal.

The importance of these relations lies in the fact that they show the structure of the methods of evaluations of the Bipartitional Functions $G\,a\,(P, Q)$ and $G\,h\,(P, Q)$ by distributions in *plano* dealt with by Dr. Sukhatme. It is not possible in the short compass of this note to bring out these relations. It is hoped to do this in detail later on.

Imperial Agricultural P. V. KRISHNA IYER.
Research Institute,
New Delhi,
March 15, 1943.

* The notations used in this note are the same as those of Macmahon in his book *Combinatory Analysis* and Sukhatme in his paper entitled "On Bipartitional Functions," *Phil. Trans. Roy. Soc.*, London, 1938, **237**, 375–409.

NEW FORMULÆ FOR THE DETERMINATION OF MAGNETIC QUANTITIES H, *l*, M AND *m*

FROM the equations $T = 2\pi\sqrt{I/MH}$ and $H \tan\theta = 2\,Md/(d^2 - l^2)^2$, we may obtain from two positions of the deflection magnetometer,

$$H = \frac{\pi\sqrt{8I}}{T}\, \frac{\sqrt{d_1/\tan\theta_1} - \sqrt{d_2/\tan\theta_2}}{d_1^2 - d_2^2}.$$

This equation gives better results for H than the equations given by Worsnop and Flint[1] and by Hutchinson.[2] The value of l (half the magnetic length) is eliminated in the above equation and hence no error arises due to its uncertainty. Attention may be drawn to this *correct* method of calculating H, since it is not usually given in College text-books.

Gordon College,
Rawalpindi, Punjab, V. R. SINGAL.
February 26, 1943.

1. *Advanced Practical Physics*, 1927, p. 441. 2. *Advanced Text-Book of Electricity and Magnetism*, 1935, p. 122.

SOME NOTES ON THE POSSIBLE REPLACEMENT OF TEETH IN *GAVIALIS GANGETICUS*

WHERE there is a continuous succession of tooth formation in a jaw, the new teeth erupting in close proximity to its predecessors, as in some species of fish, the succession has sometimes been termed "endless", but it is doubtful whether there is the constant loss and replacement which is commonly supposed to occur.

Revolving of the tooth-bearing area is out of the question at any rate in crocodiles where, according to Richard Lydekker (1896), the teeth are confined to the margin of the jaw, replacement occurring rather at the base of a shed tooth and in the same position as that of the previous tooth.

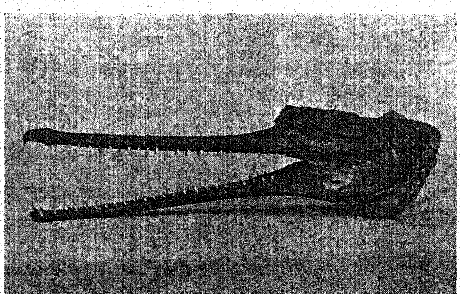
In *Gavialis gangeticus* the almost uniform spacing of the erupted teeth and the almost uniform size of many in a mature specimen shot by S. U. Nasmith in the Ganges does not support the belief that the teeth are at all commonly shed in this fish-eating species.

Although teeth may be missing or worn in old African crocodiles it is usual for the size of the teeth to correspond with the age of the individual which points to the conclusion that some at any rate are the original teeth and that only a few teeth have been shed and replaced during life.

There has been a tendency to apply human experience and what is known to occur in species with deciduous and permanent sets of teeth to all reptiles and it is even stated that the reserve teeth in a crocodile's jaw steadily push out the functional teeth, though dissection shows them independent in a hollow.

Although a new sharp tooth is usually visible at the place vacated by a shed tooth of a crocodile the phenomenon approaches that seen in the Mussel Crusher where some time elapses after a tooth is lost before the succeeding one appears, unlike the mammalian deciduous teeth whose shedding is hastened by osteoclastic action.

A successional tooth can be seen below the apex of many of the erupted teeth in a radiograph taken for me by Dr. Gordon Stewart of Durban but dissection of the *Gavialis* jaw would be necessary to determine how many exist below the twenty-nine teeth of the upper and the twenty-five teeth of the lower jaw.



Head of a twelve-to-thirteen feet specimen of *Gavialis gangeticus* shot by S. U. Nasmith, average length of exposed portion of tooth being approximately half an inch.

Experimental proof would be cruel and misleading but I have seen no sign of the apparently vestigial remains of teeth in crocodiles which I have sometimes noted in the hindermost rows of teeth in some sharks and fishes.

There can be no question that all crocodiles die with many of their reserve teeth unerupted and that, although these buried teeth serve for possible replacement when a functional tooth is lost, the production of teeth is excessive for their present needs.

West Street,
Durban, S. Africa,
February 2, 1943. F. GORDON CAWSTON.

1. Cawston, F. Gordon, "Some Notes on the Opposing Surfaces of Teeth," *S. Afr. Dent. Jour.*, 1942, **41**, 408–10, No. 12. 2. —, "A Consideration of the successional theory of teeth," *Curr. Sci.*, 1942, **11**, No. 8. 3. Ditmars, Raymond, L., "Reptiles of the World," p. 64. 4. Lydekker, Richard, "Reptiles," *Roy. Nat. Hist.*, 1896, **5**.

PIGEONITE IN THE "ABNORMAL" DOLERITE DYKES OF CHARNOCKITIC AREAS IN MYSORE

CERTAIN "abnormal" dolerite dykes from the Biligirirangan Hills have been described by Mr. B. Rama Rao, Director of Geology, Mysore Geological Department. He describes the pyroxenes of these dykes as "pink to purplish, schillerized augite", elsewhere as "purplish to pinkish titanaugite."[1]

Dykes of a similar type have been noticed near Halagur and Dodkanya, two other Charnockitic areas in Mysore. The dykes traverse the general foliation of the gneisses with a rough east-westerly trend. Microsections of specimens of the dyke show plagioclase laths and pyroxene plates disposed in a sub-ophitic texture; in other specimens the pyroxenes cluster in glomeroporphyritic groups with an occasional felspar lath entangled between them, which, in ordinary light, imparts to the rock on ophitic texture; the interspaces between the glomeroporphyritic groups are intergranular with felspar laths; at other times, the interspaces have intersertal chloritic or amphibolic material between the felspars, imparting to the whole rock the "ophimottling" or "poikilophitic" texture.

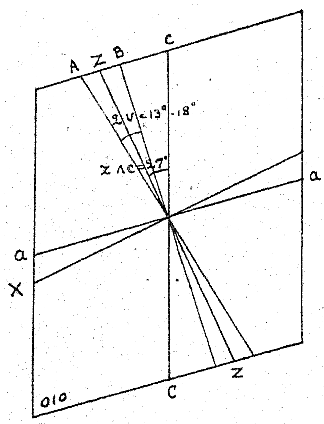
The felspars are dusted with dark dotted inclusions mostly with a clear outer rim; they are twinned on the Albite Law, the most common type being oligoclase, and the most basic type being andesine; there are occasional crystals of microline, and of orthoclase twinned on the Baveno Law; some well-zoned crystals are also present.

The pyroxenes are purplish, showing characteristic pyroxene cleavages, most of them

have kelyphytic borders, but clearer interiors. The kelyphytic borders show a brownish rim which passes outside into a greenish border, that crystallizes into an amphibole of the sodic type (with the tinge of lavender blue parallel to the Z axis) or at other times, into the brownish blue amphibole of the charnockitic type. The blue tufts in the reaction rims pass sometimes into scales of reddish brown biotite, when appear concomitantly, in the felspars, epidote and sillimanite needles. The interstitial substance bordering the sodic blue reactions are clear albite; vermicular intergrowths between albite and plagioclase (perthite), simulating micrographic texture, and intergrowths between pyroxene and felspar are often seen. The blebs of clear albite suggest sodic infusions.

The pyroxene of the dyke is a Pigeonite. It shows a small optic axial angle varying from almost uniaxial to $2V = 13°$ and $18°$. Optic sign is +ve. Contact twins on (100) are very common, strain shadows, splitting isogyres, in successive lamellæ, are observed in a (100) section.

$Z \wedge c = 27°$ in the obtuse $\angle\beta$. Positive elongation. BX_{ac} nearly $\perp r$ to c(001). XZ is $\parallel$ to 010, and bisects the acute prismatic angle. $(\gamma - \alpha) = \cdot 020$. In pleochroic varieties X = pink, Y = brownish pink, Z = pale green. The parallelism of the optic axial plane to (010) points to the Mysore Pigeonite as a calcic variety.[2]



Pigeonite from Mysore

$2V = 13° - 18°$, + ve.

$N_g - N_p = \cdot 020$

$Z \wedge C = 27°$, XZ $\parallel$ 010

Positive elongation

X = Pink.

Y = Brownish pink.

Z = Pale green.

Pigeonite from the granulites of the Charnockite series has been described by Dr. Groves.[3] He notes the predominance of the clinoenstatite-clinohypersthene molecule in the Pigeonites of Uganda and assigns them to the diopside-hedenbergite series. Similar hypersthenes in the Mysore Rocks of Charnockitic affinities are under investigation. The pigeonite, however, referred to in this note, occurring in the "abnormal" *dolerite* dykes (showing poikilophytic texture), is of the enstatite-diopside series. Computed from Winchell's variation diagrams, this pigeonite has a composition $3\,Ca\,Mg\,Si_2O_6 \cdot 2\,Mg\,Mg\,Si_2O_6$. Since the presence of the ophitic texture and microperthitic texture point towards eutectic proportions, a volumetric estimate was made of the proportions of Pigeonite to Plagioclase present in the rock, yielding the ratio 60 : 40.

Dept. of Geology,
Central College,
University of Mysore,
Bangalore,
March 19, 1943. P. R. J. NAIDU.

1. *Records, Mysore Geological Department*, 1940, **39**, 51. 2. A. N. Winchell, *Text-Book of Optical Mineralogy*, 1939, **2**, 222. 3. Dr. A. W. Groves, *Q.J.G.S.*, **91**, 155.

PROTEINS AND BLOOD FORMATION

THE customary methods of estimating the nutritional values of proteins depend upon comparing their relative efficiencies in the maintenance of nitrogen equilibrium. This is unavoidable in the present state of our ignorance concerning the specific functions in metabolism of individual amino-acids. One of the most important functions of nitrogenous food in the growing as well as in the adult animal must be the regeneration of hæmoglobin. The red blood cells undergo continuous destruction in the body, the hæmoglobin being first broken down into protein and prosthetic group and the hematin then converted into bilirubin. If as is usually assumed the average life of an erythrocyte is three weeks about five per cent. of the total hæmoglobin present in the blood must be regenerated every twenty-four hours. Part at least of the nitrogen required for this purpose must be of exogenous origin in view of the known excretion of the bile pigments in the urine and fæces and the fact that hematin administered as such by injection cannot be utilised for hæmoglobin formation.

There are, however, very few investigations on the relative value of proteins with reference to their ability to promote blood formation. Hart[1] *et al.* studied the relation of proteins to hæmoglobin formation using as experimental material rats suffering from severe nutritional anæmia resulting from an exclusive milk diet. This procedure is, however, open to the criticism that this type of anæmia is not the result of protein deprivation but of iron deficiency and the curative effect cannot be ascribed definitely to protein ingested during the period under test. Recently it was shown in this Laboratory (Yeshoda, 1942)[2] that rats made anæmic by means of phenylhydrazine provide convenient objects for the study of the hæmopoietic action of substances. Phenylhydrazine under the conditions employed produces severe anæmia without causing other adverse effects and the animal has its R.B.C. count and hæmoglobin reduced to about half the normal value

TABLE I

	Gr. 1 Casein			Gr. 2 Wheat gluten			Gr. 3 Egg albumin		
	Days		% increase	Days		% increase	Days		% increase
	4	12		4	12		4	12	
R.B.C. in millions per c. mm.	3·40	5·51	62·05	3·48	4·75	36·87	3·35	5·77	72·39
	Days		% increase	Days		% increase	Days		% increase
	5	13		5	13		5	13	
Hæmoglobin gm. per 100 c.c.	9·14	13·72	50·12	9·14	12·41	35·78	9·04	14·29	58·08

	R.B.C.	Hæmoglobin
Standard error of difference between Grs. 1 and 2 ..	3·17	2·79
do. do. do. do. Grs. 2 and 3 ..	2·38	1·10

within three to five days after the injection of phenylhydrazine.

With this procedure the relative efficiencies in blood regeneration of the three proteins casein, egg albumin and wheat gluten have been studied. As the object of the investigation was the comparison of the nutritional value of animal and vegetable proteins the whole protein of wheat rather than the gliadin and glutenin were made use of. The diets were made up to contain five per cent. by weight of the protein under investigation, the other components being Starch 75 per cent., Butter-fat 8 per cent., Sugar 8 per cent., and Salt mixture (Steenbock's 40 with small quantities of copper sulphate added) 4 per cent. Yeast and shark-liver oil were given twice a week to supply the necessary vitamins. Each diet was fed *ad lib* to a group of six young rats with initial weights of about 90 to 95 gm. The animals were made anæmic by injection of phenylhydrazine as described previously and R.B.C. count and hæmoglobin determinations were made once every four days. The average values for each group and the standard error as calculated from the data for individual animals are given in Table I. The figures given are for the first part of the experimental period, for eight days from the onset of severe anæmia (fourth or fifth day after injection of phenylhydrazine).

It will be seen that while casein and egg albumin are equally efficient in blood regeneration wheat gluten is markedly inferior to the two animal proteins and produces a much slower rise in the hæmoglobin and erythrocyte content. It was further found that while normal R.B.C. and hæmoglobin were restored in about fifteen days in the groups on the first two proteins, the animals receiving wheat gluten returned to normal only at the end of twenty-five days. Records of food intake show that the differences were not due to differences in the quantity of protein consumed.

Experiments on other vegetable and animal proteins and on the effect of feeding protein at different levels are in progress.

Our thanks are due to Mr. D. L. Rajalakshman of the Department of Statistics for the statistical analysis of the results.

University Biochemical Laboratory, Madras,
March 30, 1943.
M. DAMODARAN.
P. K. VIJAYARAGHAVAN.

1. Hart, Elvehjem, Pearson, *J.B.C.*, 1937, **119**, 749.
2. K. M. Yeshoda, *Curr. Sci.*, 1942, **11**, 360.

COMBINED DETERMINATION OF THIAMIN AND NICOTINIC ACID IN FOODSTUFFS BY CHEMICAL METHODS

IN recent years numerous chemical methods have been described for the individual estimation of thiamin[1-8] and nicotinic acid[9-13]. All the procedures described for the extraction of nicotinic acid are, however, drastic and give rise to highly coloured solutions especially with materials of plant origin thereby necessitating separate blank estimations in every case. Further, Kodicek[13] and Waisman and Elvehjem[14] obtained higher values for the nicotinic acid content of cereals than could be accounted for by their biological potency.

In the present investigation, a simple procedure was evolved whereby a combined determination of thiamin and nicotinic acid could be made on the same sample. Further, the final solutions obtained with the majority of foodstuffs were practically colourless or contained only a trace of yellow, which was so small that it could not be estimated by an ordinary Klett Colorimeter.

One to ten grammes of the foodstuff was digested at pH 6-7 for 20-24 hours at 37° C. with an enzyme preparation, prepared from pig's intestinal mucosa. The proteins and other interfering substances were removed by precipitation with basic lead acetate at pH 7·0 and the excess of lead was removed as lead sulphate. An aliquot of the solution after lead treatment was used for the estimation of thiamin by the thiochrome method (Narasinga Rao, unpub-

Foodstuff	Thiamin				Nicotinic Acid			
	Enzymic hydrolysis		Autolysis with water		Enzymic hydrolysis		Autolysis with water	
	$\mu g./g.$	% recovery	$\mu g./g.$	% recovery	$\mu g./g.$	% recovery	$\mu g./g.$	% recovery
Yeast								
Brewer's	97·9	92·3	96·2	96·0	436·7	95·0	436·7	95·0
Torula (grown on molasses medium) .. .	26·0	97·8	21·0	104·0	215·93	93·0	—	—
Nuts								
Groundnut (*Arachis hypogæa*) (ether extract) ..	16·7	99·0	—	—	—	—	—	—
Animal Tissues								
Sheep, liver	5·8	86·7	5·2	88·8	168·5	100·0	168·5	100·0
,, heart	4·8	95·2	3·8	81·0	37·0	—	35·1	—
Cereals								
White maize (*Zea mays*) ..	4·2	101·0	4·7	86·4	11·8	105·0	9·8	92·8
Wheat (*Triticum vulgare*) ..	3·9	89·6	3·9	89·6	23·8	96·8	—	—
Pulses								
Bengal gram (*Cicer arietinum*)	4·9	87·0	—	—	20·0	93·3	—	—
Red gram (*Cajanus indicus*)	3·8	102·0	3·5	96·0	23·0	86·0	—	—

lished results) and another portion was taken for the nicotinic acid test, after being heated in a boiling water-bath for 30-40 minutes to hydrolyse nicotinic amide to nicotinic acid. The latter was brought to pH 7·0, and nicotinic acid was estimated according to Swaminathan's method.[15] The results of tests carried out with various foods are shown in the table.

The figures for percentage recovery given in the table show that enzyme digestion is the best means of liberating and extracting the two vitamins. Further, the method is also effective in reducing the interference by extraneous substances to a minimum. In the case of fresh foods and yeast preparations, dried in the sun, mere autolysis with water at pH 6-7 was found to liberate both thiamin and nicotinic acid from their biological combinations (see table). However, the use of the enzyme preparation is recommended to ensure complete liberation of the vitamins from all types of foods.

Nutrition Research Laboratories,
Indian Research Fund Association,
Coonoor, KAMALA BHAGVAT.
March 8, 1943.

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TOXICOLOGY OF FOOD COLOURS AND THE NEED FOR THEIR DETAILED PHARMACOLOGICAL EXAMINATION

VARIOUS types of colouring matters, from coal-tar products or from vegetable and mineral sources, have been used by manufacturers of food and dairy products for a long time in Europe and America. Addition of a colour or a mixture of colours to render processed food preparations or beverages 'attractive' and sometimes, also to conceal damage, adulteration or inferior quality is a very common procedure in industrial countries, more particularly marked in America during the last two decades. The problem is slowly assuming importance in India in connection with the proposed colouring of 'vegetable ghee' (hydrogenated vegetable fat) to make it look 'distinctive' from cow or buffalo ghee (clarified butter).

Coal-tar dyes being most readily available during the pre-war days at reasonable prices naturally attracted more attention in India, as elsewhere. As ordinarily manufactured for textile or other industrial purposes, dyes often contain impurities (*e.g.*, traces of arsenic from nitric or sulphuric acid almost invariably used in dye manufacture, lead and copper from utensils employed, harmful organic compounds and intermediates produced by side reactions, etc.), some of which are harmless, whereas others are toxic. These impurities may not detract from the value of the dyes for industrial use, but they would be highly objectionable in a substance designed for human consumption. The Food and Drug Administration of the United States Department of Agriculture[1] have, after careful pharmacological and toxicological examination extending for years, adopted a list of *fifteen* oil- or water-soluble dyes of various shades for purposes of certification to the trade as 'harmless' (in certain concentrations) for human consumption. No dyes outside this list are permitted to be employed until the Federal Administration is

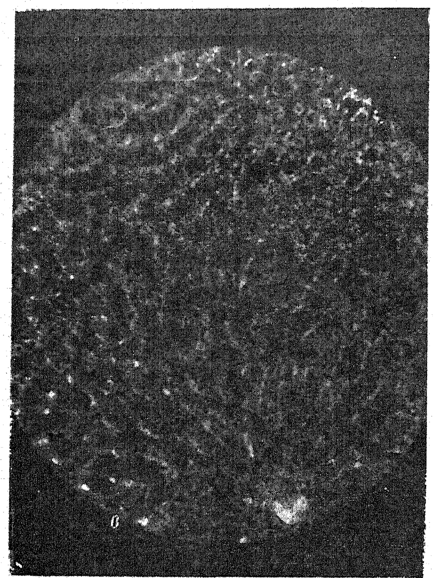

FIG. 1

Liver of a rat, ♂ 210 gm. fed daily with Oil Orange E in arachis oil (approx. 0·4 % dye concentration) well marked degeneration of liver cells (periportal): areas of healthy liver cells round the central vein. The black spots to the left of the vein are eosinophilic infiltration.

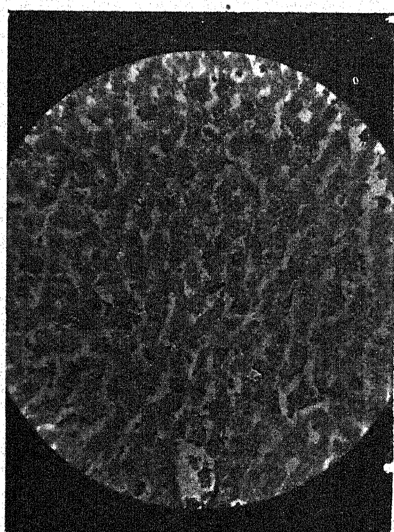

FIG. 2

Liver of a control rat on identical diet minus Oil Orange E. No pathological change is noticed.

satisfied about its purity and absolute safety after a critical and elaborate study of the chemical, pharmacological and toxicological properties of the dye.

During the last two years, the Biochemical Standardisation Laboratory was afforded the opportunity of investigating the pharmacological and toxicological properties of two food colours, one of coal-tar origin (Oil Orange E or Benzene-azo-β-naphthol), and another of vegetable origin, 'Ratanjot' (*Onosma echiodes*). 'Chronic' feeding experiments on white rats extending for 2-4 months were carried out with the dyes in different concentrations (colour intensity readings recorded by means of the Lovibond Tintometer—1938 model), following, in essential, details recommended by Hesse.[2] *Post-mortem* examinations of liver, kidney and heart were made at various stages of the feeding experiments and histopathological changes recorded in permanently mounted paraffin sections.

Addition of 'Oil Orange E' to arachis oil in a concentration adequate to bring the Tintometer reading approximately to 30 Yellow and 30 Red Units (heated to 160-170° C. in presence of moisture as obtainable in ordinary cooking) when fed to white rats in a dosage of about 0·5 c.c. per rat (average weight, 150-200 gm.) every day for 60 days produced loss of weight and a demonstrable pathological change in the liver (see microphotographs). In a less extensive study on rats, Basu[3] has also recorded loss of weight after 8 weeks' continuous feeding, associated with liver and kidney congestion or degeneration. We could not demonstrate any pathological change in the kidney and heart simultaneously with the liver changes.

Organic colouring matters of natural origin such as vegetable colours are usually, relatively speaking, harmless in themselves, or free from harmful impurities. In this class of colouring matters also, it appears desirable to exercise some vigilence, particularly in regard ot the amount of dye to be used daily and the concentration in which it is likely to be ingested along with edible fats. Our experience with 'Ratanjot' as a colouring agent seems to indicate that, in fairly high concentrations and under certain conditions of administration, even a vegetable dye can bring about toxic manifestations as evidenced by pathological changes in the liver and loss of weight of the experimental animals. Whether it is due to any impurity introduced into the dye in the process of extraction or to other factors is yet unknown. Details of the investigations will be published elsewhere.

The need for regular 'certification' of new food colours and the preparation of a list of 'permitted' dyes obtainable from indigenous vegetable and mineral sources (after very thorough and critical pharmacological and toxicological examination) are, therefore, of importance in the interests of consumers of coloured food and dairy products in India. This should be done preferably through a State

Organization, as in America and other European countries.

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1. "Service and Regulatory Announcements. Food and Drug No 3 (First Revision)", *U.S. Dept. of Agriculture Bulletin*, Sept. 1931. 2. Hesse, "Coal-tar colours used in food products", *U.S. Dept. Agri. Chem. Bul.*, 1912, **147.** 3. Basu, *Ind. Jour. Pharm.*, 1941, **3,** 193.

ACTION OF SULPHONAZIDES ON HETEROCYCLIC COMPOUNDS

IN exploring the various possible methods of synthesis of sulphanilamido derivatives of heterocyclic compounds, we came across the reaction discovered by Curtius and Rissom[1] which appeared to give access to compounds otherwise difficult to prepare. This reaction, which can be represented as follows

$$p\text{-R-C}_6\text{H}_4\cdot\text{SO}_2\text{N}_3+\text{R'H}\rightarrow p\text{-R}\cdot\text{C}_6\text{H}_4\cdot\text{SO}_2\text{NH}\cdot\text{R'}+\text{N}_2$$

where R = H, Me, Cl and NH·Ac

has been extensively studied by Curtius and collaborators.[1] It has been found that in case R'H is benzene, toluene, xylene or naphthalene, the reaction proceeds as represented above, but with aniline, mono-methyl and dimethylaniline it is more complicated yielding other products also, one of them being the sulphonamide ($R.C_6H_4.SO_2NH_2$) arising from the azide. While pyridine yields a (2- or 3-substituted) benzenesulphonamido derivative, with quinoline the only crystalline product isolated is the sulphonamide corresponding to the starting azide.

We have studied, in the first instance, the action of acetsulphanilylazide[2] on thiazole, 2:4-dimethylthiazole, 2-hydroxy-4-methyl thiazole, pyridine and glyoxaline.

Thiazole and 2:4-dimethylthiazole in excess were kept boiling with acetsulphanilylazide till there was no more evolution of nitrogen (12 to 24 hours). In both the cases, the volume of gas collected corresponded roughly to one molecular equivalent. From the reaction products, the only crystalline product that could be isolated in the two cases was p-acetaminobenzenesulphonamide in yields of 25 and 5-10 per cent. respectively. Similarly p-toluenesulphonazide and 2:4-dimethylthiazole furnished only p-toluenesulphonamide in 75 per cent. yield. The action of acetsulphanilylazide on 2-hydroxy-4-methylthiazole led to no tangible product.

Pyridine on boiling with acetsulphanilylazide as described above furnished in poor yields an acetsulphanilamidopyridine, m.p. 280°, which appears to be the 3-substitution product (the m.p.s of the 2-, 3-, and 4-substituted products recorded in literature[3] are 224-227°, 272-275° and 252° respectively).

Glyoxaline in sharp contrast to all compounds studied so far reacted very violently with one molecular equivalent of acetsulphanilylazide at 80 to 110°; one molecular equivalent of nitrogen was evolved in less than a minute and the product obtained was a tar. When, however, the reaction was carried out in small quantities carefully regulated, one molecular equivalent of nitrogen was evolved in about thirty minutes; the product obtained was a mixture from which two crystalline compounds were isolated (with very indefinite m.p.) none of which is identical with p-acetaminobenzenesulphonamide. The structures of these are under investigation.

We are studying the action of the sulphonazides on various other compounds.

Haffkine Institute,
Parel, Bombay,
March 29, 1943.

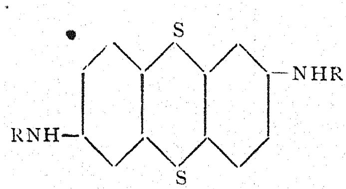
(MISS) B. S. ALAMELA.
K. GANAPATHI.

1. Curtius and Rissom, *Z. angew. Chem.*, 1913, **26,** 134; Curtius and Lorenzen, *J. prakt. Chem.*, 1898, (2), **58,** 160; Curtius *et al.*, *Ibid.*, 1930, (2), **125,** 303. 2. Curtius and Stoll., *Ibid.*, 1926, (2), **112,** 117. 3. Crossley, Northey and Hultquist., *J. Amer. Chem. Soc.*, 1940, **62,** 372; Tuda, Iticawa and So, *J. Pharm. Soc., Japan*, 1939, **59,** 213; Roblin and Winneck, *J. Amer. Chem. Soc.*, 1940, **62,** 1999; Winterbottom, R., *Ibid.*, p. 161; Soc. Rhone Poulenc, Fr. 846, 191; *C.A.*, 1941, **35,** 1184.

SYNTHESIS OF SULPHANILAMIDE DERIVATIVES OF THIANTHRENE

SULPHANILAMIDO compounds possessing heterocyclic rings have come into great prominence as therapeutic agents with the discovery of sulpha-pyridine (B.P. 516288), sulphathiazole, etc. The disulphanilamido derivative of 2:6-diamino-thianthrene has now been prepared.

2:6-Diacetaminothianthrene was prepared according to the method of Ray.[1] The corresponding diamine was obtained from the diacetyl compound by hydrolysis with hydrochloric acid and neutralising with alkali (yellow needles, m.p. 120° C.). p-Acetamino-benzene-sulphochloride reacts with 2:6-diamino-thianthrene to yield the diacetyldisulphanilamide of thianthrene (I) which decomposes at 180°.



(I, R = $-SO_2\cdot C_6H_4\cdot NHAc$)

Organic Chemistry Section,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
March 12, 1943.

P. C. GUHA.
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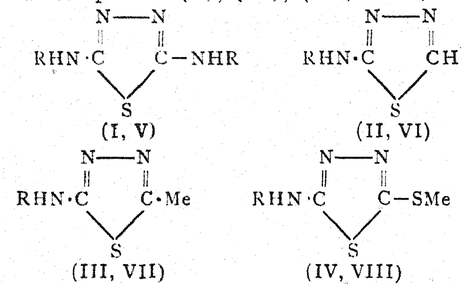
1. *J.C.S.*, 1921, **119,** 1964.

ON SULPHANILAMIDE DERIVATIVES POSSESSING HETEROCYCLIC RINGS: SULPHANILAMIDOTHIOBIAZOLES

p-ACETAMINO-BENZENE-SULPHONYL CHLORIDE reacts with (*i*) 2:5-diamino-1:3:4-thiodiazole, (*ii*) 2-amino-1:3:4-thiodiazole, (*iii*) 5-methyl-2-amino-thiodiazole and (*iv*) 5-methylthiol-2-amino-1:3:4-thiodiazole, to yield the corresponding heterocyclic sulphanilamido compounds (I), (II), (III) and (IV) melting respectively at 250-54°, above 300°, 200° (decomp.), and 216-18°. The four acetyl sulphanilamides have been hydrolysed to the corresponding sulphanilamido compounds (V), (VI), (VII) and (VIII),



(I, V) (II, VI) (III, VII) (IV, VIII)

[I-IV, R = $-SO_2 \cdot C_6H_4-NHAc$)
V-VIII, R = $-SO_2 \cdot C_6H_4-NH_2$)]

melting respectively at 223°, 213-14°, 186-87° and 198°. Their toxicity and therapeutic efficiency are under investigation.

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Bangalore, P. C. GUHA.
March 12, 1943. D. B. DAS GUPTA.

CHANGE OF THE GENERIC NAME *PISIONELLA* AIYAR AND ALIKUNHI, 1940, INTO *PISIONIDENS* (*POLYCHAETA*)

SINCE the genus *Pisionella* was erected in 1940[1] for a new Pisionid from the Madras beach, we have found from the *Zoological Records* for 1940, received here in November 1942, that a genus of the same name and family proposed by Hartman[2] for a Peruvian polychæte worm has priority. We are satisfied from a comparison of the descriptions of the worms given by Hartman and ourselves that the Indian worm is entirely different from the Peruvian. We, therefore, propose for our genus the new name *Pisionidens*, which will be the fourth genus of the family Pisionidæ. The Madras Picionid will, therefore, be known as *Pisionidens indica.*

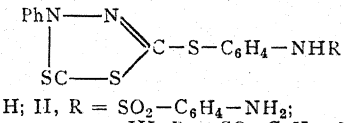
University Zoological Research
Laboratory, Madras, R. GOPALA AIYAR.
April 2, 1943. K. H. ALIKUNHI.

1. *Rec. Ind Mus.*, March 1940, **42**, pt. 1, 89-107.
2. *Rept. Allan Hancock Pacific Exped.*, August 1939, **7**, Nos. 1 and 2, 91-93.

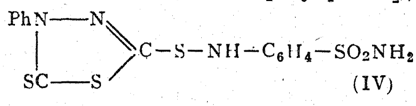
SYNTHESIS OF SULPHANILAMIDE DERIVATIVES OF MIXED SULPHIDES POSSESSING HETEROCYCLIC RINGS

THE disulphide of phenyldithiobiazolonyl mercaptan gives the aminophenyl sulphide (I) by the action of aniline, and (I) by reacting with *p*-acetaminobenzene sulphochloride, furnishes the sulphanilamido derivative of the mixed sulphide, *viz.*, (II), m.p. 222°; the deacetylated compound (III) melts at 173°. Phenyl dithiobiazolonyl-*o*-amino-tolyl sulphide, however, does not react with the sulphochloride.

Phenyldithiobiazolonyl disulphide reacts with sulphanilamide to yield *p*-sulphonamido phenyl derivative of phenyldithiobiazolone sulphamine (IV), m.p. 155°.



I, R = H; II, R = $SO_2-C_6H_4-NH_2$;
III, R = $SO_2 \cdot C_6H_4-NH_2$);



(IV)

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March 12, 1943. V. M. DOKRAS.

THE PRESENCE OF A HITHERTO UNDESCRIBED TYPE OF MUSCLE-FIBRES IN THE SEPTA OF *PHERETIMA POSTHUMA* (VAILLANT)

THE occurrence of various kinds of muscle-fibres has already been noted in the septa of Oligochæta by several workers (de Ribacourt, 1901[1]; Kuhlmann, 1908[2]; Pointner, 1911[3]; Nomura, 1913[4], 1915[5]; Bahl, 1919[6]; and Stephenson, 1925[7], 1930[8]), and Bahl (1919) has given a fairly detailed account of the septa in *Pheretima* with particular reference to the sphinctered apertures. Our knowledge of the derivation of the muscle-fibres in the septa of the Oligochæta, however, is all but too incomplete, being limited to only a few observations. According to Pointner (1911), some of the septal muscular fibres in *Isochæta* (*Limnodrilus*) *virulenta* can be referred to the longitudinal and circular muscular layers of the parietes, while the others cannot. Bahl (1919) finds that the muscular strands in the anterior five septa (5/6, 6/7, 7/8, 8/9 or 9/10, and 10/11) in *Pheretima posthuma* pass to the body-wall or to other septa in order to support them and keep them in position. Stephenson (1930) remarks that the muscular fibres in the septa of the Oligochæta are mainly derived from the longitudinal muscular layer of the parietes.

While engaged in studying the role of septa in ingestion, peristalsis and egestion in Indian earthworms last year, I noted peculiar muscular fibres in the septa of *Pheretima posthuma* (L. Vaillant), which have apparently escaped

observation so far. These fibres (Fig. 1, *p.e.f.*) are not continuations of the longitudinal muscular fibres of the parietes, as might be expected, but after traversing the septa, pass over into the wall of the intestine and actually form part of the longitudinal muscular layer of that organ. As far as I have been able to ascertain, such a continuation of septal muscle-fibres from the parietal musculature to the enteric musculature has not been recorded hitherto. Their disposition, particularly their

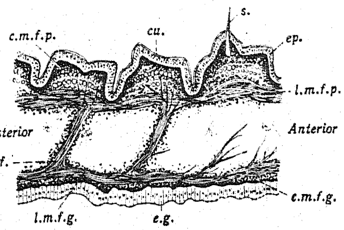

FIG. 1

Longitudinal section through the mid-body of *Pheretima posthuma*, showing the region dorsal to the gut.

c.m.f.g., circular muscle fibres of the gut; *c.m.f.p.*, circular muscle fibres of the parietes; *cu.*, cuticle; *e.g.*, epithelium of the gut; *ep.*, epidermis; *l.m.f.g.*, longitudinal muscle fibres of the gut; *l.m.f.p.*, longitudinal muscle fibres of the parietes; *p.e.f.*, parieto-enteric fibres; *s.*, seta.

relation to the longitudinal muscular layers of both the body-wall and the gut, indicates a special significance in peristalsis, and one might perhaps justifiably assign to them the role of co-ordinating the muscular contractions of the body-wall with the peristaltic movements of the enteric canal. In view of their peculiar relations, these fibres may be called the *parieto-enteric fibres*.

In this connection one might also mention another relation between the parietal and the enteric longitudinal muscle-fibres which occurs in the anal segment and has not been recorded so far. In this segment (Fig. 2) the longitudi-

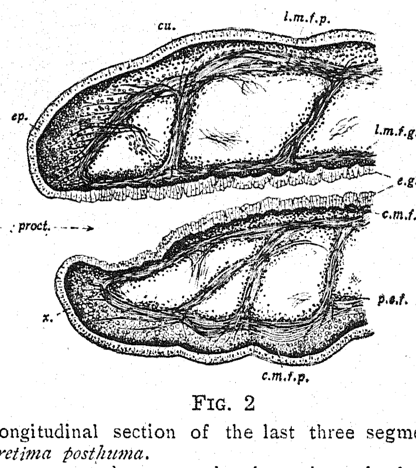

FIG. 2

Longitudinal section of the last three segments of *Pheretima posthuma*.

proct., proctodæum; *x*, the place where the longitudinal muscle fibres of the body-wall curve round to pass on into those of the gut. (Other abbreviations as in Fig. 1.)

nal muscular fibres of the body-wall curve round towards the proctodæum and pass over into the enteric wall as part of its longitudinal layer.

My best thanks are due to Mr. Beni Charan Mahendra for his help and guidance in the preparation of this note, as well as to Dr. R. K. Singh, Principal, Balwant Rajput College, for much encouragement.

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January 25, 1943.

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ON THE THALIACEA OF THE MADRAS PLANKTON

THE only collection of Salps made previously from the different regions of the Bay of Bengal is that by the R.I.M.S. *"Investigator"* Expedition. The collections were mostly from the Burma Coast, Mergui Archipelago, Revello Channel and Nankauri Harbour and comprise twelve species of *Salpa* and four species of *Cyclosalpa* (Bomford, Oka and Sewell). The German Deep Sea *"Valdivia"* Expedition, while passing from Sumatra to Colombo, collected six species of *Salpa*, three species of *Cyclosalpa* (Apstein), five species of *Doliolum* and Nurse Forms (Neumann). Herdman has also recorded three species of *Salpa*, *Doliolum* sp. and Nurse Forms in the Ceylon waters.

Thetys vagina, *Salpa fusiformis* and *Ritteriella hexagona* were collected from the Madras Coast by the *"Investigator"* Expedition during the months of January and February 1894, from depths ranging from 133 to 250 fathoms. As a result of intensive study of the Plankton collections made in this Laboratory, a large number of forms previously unrecorded from this Coast have been brought to light and it is very likely that these forms will be found to have a wider distribution though it is disconcerting to note that the three species mentioned above do not find a place in this collection. The following forms have been obtained from the Madras Plankton:—

HEMIMYARIA—

1. *Cyclosalpa pinnata* var. *sewelli* Metcalf. (Solitary.)
2. *Cyclosalpa pinnata* var. *polæ* (Sigl). (Solitary and Aggregate.)
3. *Brooksia rostrata* (Traustedt). (Solitary.)
4. *Ritteriella amboinensis* (Apstein). (Solitary.)
5. *Salpa maxima* Forskål. (Aggregate.)
6. *Salpa maxima* var. *tuberculata* Metcalf. (Aggregate.)
7. *Salpa cylindrica* Cuvier. (Solitary and Aggregate.)

8. *Jasis zonaria* (Pallas). (Solitary and Aggregate.)
9. *Thalia democratica* (Forskål). (Solitary and Aggregate.)
10. *Pegea confœderata* (Forskål). (Solitary and Aggregate.)
11. *Traustedtia multitentaculata* (Quoy and Gaimard). (Solitary.)

CYCLOMYARIA—

1. *Doliolum denticulatum* Quoy and Gaimard.
2. *Dolioletta gegenbauri* Uljanin.
3. Two kinds of Nurse Forms.

A detailed account of the forms mentioned above together with information regarding their periodicity, as seen from their occurrence in townet collections made during the last five years, will be given when publication facilities become normal.

Zoological Research Laboratory,
University of Madras, R. VELAPPAN NAIR.
April 3, 1943. R. GOPALA AIYAR.

1. Bomford, T. L., *Rec. Ind. Mus.*, Calcutta, 1913, **9.** 2. Oka, A., *Mem. Ind. Mus.*, Calcutta, 1915, **4, 1.** 3. Sewell, R. B. S., *Rec. Ind. Mus.*, Calcutta, 1926, **28.** 4. Apstein, C., *Wiss. Erg. Deutsch. Tiefsee-Exp.*, 1906, **42, 3.** 5. Neumann, G., *Ibid.*, 1906, **12, 2.** 6. Herdman, W. A., *Pearl. Oyster Fish. Rep.*, Ceylon, 1906, **5.**

EFFECT OF STORAGE TEMPERATURES UPON THE VISCOSITY BEHAVIOUR OF POTATO STARCH

THE viscosity of 1 per cent. potato starch-paste varies from season to season. This is a great handicap in the sizing of fabrics as the amount of size taken up depends upon the viscosity of the size.

In Fig. 1 the viscosity behaviour of a high grade potato starch together with some commercial samples of potato starches is shown.

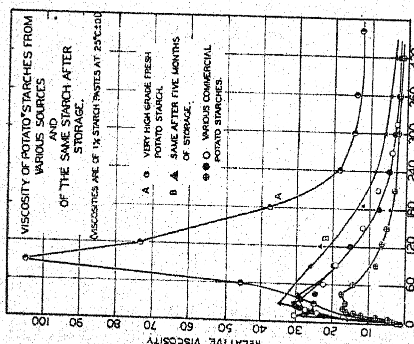

FIG. 1

Curve A was determined in January 1935 while Curve B was obtained for the same starch after five months of storage. The other curves are of several commercial starches obtained from various places during July of 1935.

It will be seen from Curves A and B of Fig. 1 that enormous differences exist in the viscosity behaviour of the same sample of starch during winter and summer. It was thought that the temperatures of storage might have been the cause of this wide variation.

A fresh sample of potato starch was obtained from the Presque Isle Mills of the New England Starch Company through the late Dr. J. R. Katz (in whose laboratory this work was carried out at Cambridge, Mass., U.S.A.) in the first week of July 1935 and its viscosity determined. This sample showed the lowest viscosity that the author has observed in potato starches. On July 11th, 1935, 25-gram samples of this starch were hermetically sealed in Pyrex glass tubes to avoid any differences due to moisture changes during the period of storage. One sample was kept in a refrigerator at 4° C., another in a room where the temperature during day remained around 21° C., and a third at a temperature of 30° C. The tubes were cut open during the last week of September 1935 and the viscosity of 1 per cent. pastes determined in the usual manner.[1] The results are shown graphically in Fig. 2.

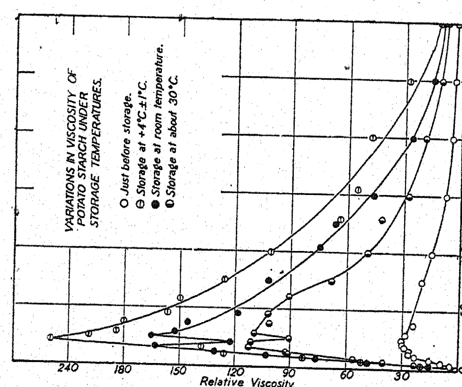

FIG. 2

It will be seen that the temperature of storage has greatly affected the viscosity behaviour of starch. The sample stored at 4° C., records the highest viscosity. The lower the storage temperature. the higher will be the maximum viscosity attained. The results seem to indicate a reversible reaction of the type

$$\text{High viscosity starch} \underset{\text{Low temperature of storage}}{\overset{\text{High temperature of storage}}{\rightleftharpoons}} \text{Low viscosity starch}$$

College of Agriculture,
Poona, MANOHER C. DESAI.
February 11, 1943.

1. Katz, J. R., Desai, M. C., and Seiberlich, J., *Trans. Faraday Soc.*, 1938, **34**, 1258.

REVIEWS

The Life of Sir J. J. Thomson. By Lord Rayleigh. (Cambridge University Press, London), 1942. Pp. x + 299. Price 18*sh.*

Sir J. J. Thomson's own *Recollections and Reflections* is already available to those who wish to understand and appreciate J. J. But, there are several facts and incidents which J. J. had skipped over in his account for reasons of modesty. Besides, a clear and coherent account of his life by anyone except himself is most necessary when it is realised that J. J. and his school really laid the foundation of modern physics. The book under review fulfils both these wants. It does not in any way duplicate J. J.'s own account. It is written in a complete, accurate and extremely lucid form. Lord Rayleigh has done a signal service to the scientific world in general and to physicists in particular by writing this excellent and much needed book.

The first chapter gives an account of J. J.'s life till his appointment as Cavendish Professor of Physics at Cambridge. It would have been better if the author had devoted a little more space and given some more details of J. J.'s early life. Chapter II provides factual information of J. J.'s early days at the Cavendish. Chapters III, IV, V, VI and IX give an account of J. J.'s contribution to physics. These chapters are most beautifully written and bring out very clearly the importance and outstanding excellence of the contributions made by J. J. and his school to physics. Few can excel Lord Rayleigh in presenting in a proper perspective the difficulties and the outstanding excellence of these pioneer experiments. These chapters contain plenty of good physics most eminently described and no one interested in physics can afford to miss them.

The rest of the book represents a faithful account of the varied aspects of J. J.'s life and career. The chapters on J. J. as Master of Trinity contain graphic descriptions which can hold the attraction of even the most disinterested reader. Controversial points like J. J.'s correspondence with Sir James Dewar when J. J. was President of the Royal Society and J. J.'s correspondence with the late Lord Rutherford prior to the latter applying for the Cavendish Professorship come up for the most lucid description and bring out clearly J. J.'s wide outlook and broadmindedness. The last chapter on J. J.'s closing years is written in a most touching way and the reader as he goes through it becomes one with J. J.'s admirers and feels fully the respect and regard that all had for J. J.

The book is in itself a most fitting memorial to J. J. This is really no overestimate! The printing and get-up are excellent. The reviewer has absolutely no hesitation in saying that the book will be a valuable addition to any library, public or private.

S. V. CHANDRASEKHAR AIYA.

Annual Review of Physiology, Vol. IV, 1942. Editors J. M. Luck & V. E. Hall. (Americ. Physiological Society and Annual Rev. Inc., California), 1942. Pp. 709. Price $5.0.

Although the war has further limited the possibilities of receiving scientific contributions from a large part of the world, nevertheless a huge material was collected and reviewed in this volume. In 23 chapters 3,925 papers have been critically evaluated and all the important results obtained up to the second half of 1941 have been lucidly arranged. Obviously, it is impossible to reproduce in a few lines the contents of this *Review* which fill 55 pages of a subject index. An excellent staff of collaborators, most of them being leading experts in their own field, not only succeeded in producing a most useful and reliable work for ready reference but also a very readable and stimulating manual, presenting a balanced picture of the progress made in those subjects, which are included in the present volume. In the section on "permeability" *Blinks* reports the revolutionary results, achieved by using artificial radioactive elements as tracers of permeability. *Aebersold* and *J. H. Lawrence* survey "the physiological effects of neutron rays" which would become more effective than X-rays in destroying malignant tissues if boron could be introduced into the growth. The chapter on "physiological aspects of genetics" by *Strandskov* shows the importance of this young science for the understanding of immunology and endocrinology. *Hamilton* and *Willier* treat the influence of hormones and nerve correlation on "developmental physiology". *J. P. Peters* in the section on "water metabolism" deals with the distribution of water in the body, the forces that determine its allocation to various compartments of the system and the interchanges between them and the factors—especially endocrine influences—that control exchanges of water with the environment. Results of experiments on "growth" and differentiation in seed plants and slime molds are reported by *Avery, Jr. Chambers, Shorr* and *Barker* present the recent contributions to our knowledge of environmental and hormonal influences on "energy metabolism", including that of organs and isolated tissues. A short but interesting section on "the physiology of the skin" with special reference to pain and itching by *Baird Jr., Lever* and *Spies* is followed by *Hertzman's* survey of "the peripheral circulation", which contains some important material on the vasomotor system and shock. Very instructive is *Visscher's* article on the "heart", including results of clinical and pharmacological interest. *H. P. Smith's* chapter on "blood" gives a useful review of all aspects of blood coagulation and discusses recent investigations on erythrocyte formation. *Van Liere's* report on the "digestive system" abstracts numerous (200) papers on salivary secretion, gastric and intestinal secretion and absorption, on motility and allied subjects. An important

contribution is *Shannon's* chapter, dealing with the "kidney". He considerably clarifies the position regarding fundamental problems such as discrete renal processes and their interrelation, excretion of water and electrolytes and experimental hypertension. Progress achieved in "electrophysiology" is well brought out by *Gerard*; it becomes clear that electric currents in cells and tissues are involved in the integration of function, metabolism and growth. New results, obtained in neurophysiology, are to be found in the sections on "spinal cord and reflex action" by *Ruch*, "the central nervous system by *Hines* and "the autonomous nervous system" by *Hare* and *Hinsey*, which cover adequately the advances made in these almost unlimited subjects, which include such interesting topics as the extension of synaptic surface on the nerve cell, the status of the ventral horn cell, a new function of the anterior cerebellar lobes and the complex problems of reflex physiology. Among the contributions to the physiology of "sense organs", critically arranged by *Hartline,* should be mentioned that the retinal mechanisms concerned with colour vision have been explored with the aid of a microelectrode, a method which permits discerning clearly the activity of individual retinal ganglions. Out of the "metabolic functions of the endocrine glands" *C. N. H. Long* considers especially those of the anterior pituitary, the adrenal cortex and the pancreas. More than 480 contributions to "the physiology of reproduction" have been reviewed by *Hisaw* and *Astwood;* they give a clear-cut picture of the present-day opinions on the œstrous cycle, metabolism and physiological effects of sex hormones, menstruation, sexual skin of primates, lactation and placental hormones. *C. P. Richter* impresses upon the reader the increasing interest in "physiological psychology", which has led to considerable advances, made in electroencephalography and the treatment of mental disturbances by frontal lobectomy, electrical shock and hormones. Those interested in physiology, applied to modern warfare, will find the article by *Behnke* and *Stephenson* full of interesting informations; they deal, especially, with the effect of low and fluctuating pressure in aviation and high pressure in diving and the submarine service; also problems of health preservation under extreme conditions are treated. The concluding chapter by *M. I. Smith* deals with "the pharmacology of drug addiction", limiting the drugs concerned to morphine and derivatives, alcohol, cocaine, barbiturates, amphetamine, acetanilide and cannabis.

This publication, containing a masterly digested inexhaustible material, pertinent to so many branches of biological and medical science, is a real asset to post-graduate students, teachers and research workers, offering to all of them the most reliable information on the recent position of many physiological and clinical problems. Under the present circumstances, when foreign literature reaches this country extremely delayed, when hardly any one volume of the journals and magazines contains all the issues, due to the hazards of communication, we do not think that the value of this *Annual Review* could be exaggerated or a subsitute for it could be found.

ROBERT HEILIG.

Yantrik Shodhachya Navinyakatha. By K. A. Damle, B.Sc. (Published by the author at Damlewada, Shastripol, Baroda), 1940. Pp. 140. 46 Figs. Price Rs. 1-8-0.

This publication is the first of a series entitled 'Vijnanmala' published by the author himself. The book is a narrative about some of the inventions with the results of which we are quite familiar. The book is in Marathi and perhaps it is the first of its kind in the language. It is written from the point of view of the general reader and although it is concerned with what may be described as technical matter, the method of presentation is such that it forms a very interesting reading indeed.

The first chapter deals with the birth and growth of the sewing machine while the third gives the story of the bicycle. It is followed by two other chapters, the first telling us as to how the typewriter came into existence and the way it assumed its present form and the second about the various inventions that have made possible the remarkable development that has taken place in the art and technique of the printing press. After this there is a discussion about the possible advantages and disadvantages of the machine age. Finally, there is the fascinating history of the gramophone.

When the time comes for taking out a second edition of the book—which it is hoped will be soon—the following suggestions may be considered. The order of the chapters may be slightly altered so that chapter two comes first while chapter six goes to the end. A few more diagrams may be added with explanatory notes. At the end of each chapter a sequence of different steps which go to make the particular invention may be given.

There is one more point which deserves mention and that is the satisfactory manner in which the author has rendered into Marathi various technical terms for which there were no ready equivalents. Altogether this book is a praiseworthy attempt on the part of the author and deserves congratulations.

Mineralogy, Petrology and Economic Geology—Tables for the Use of Geologists, Prospectors and Mining Engineers. By N. L. Sharma. (Indian Society of Engineers, Calcutta), 1942. Pp. 22. Price Rs. 3-8-0.

The booklet is divided into three chapters. The first deals with mineralogy, the second with petrology and the third with economic mineralogy. Each chapter consists of a number of tables which are meant as ready reckoners for a geologist, or a student of the subject. Two tables are dedicated to crystallography, six to physical characters of minerals, one for chemical composition, one for blowpipe tests and one for microscopic characters. There are three tables for petrology treating respectively with Igneous, Sedimentary and Metamorphic rocks. The chapter on Economic Geology also comprises of three tables, one

indicating the uses to which various minerals are put, the second giving the classification of deposits and the third showing the distribution of economic minerals in India. Each table is preceded by a small introductory note. The great utility of a booklet of this nature for students of the subject cannot be gainsaid and Mr. Sharma should be complemented on this work.

The value of the booklet would be enhanced by a foreword or an introduction giving the scope and the procedure adopted. The title gives the impression that it is mostly meant for the professionals but at the end of the first page it is stated that it is meant for students. The notes given are too elementary for the understanding of the tables especially in crystallography and optical mineralogy. Both morphological and physical mineralogy (p. 1) may be included under the general term physical characters. The term 'crystalline habit' and 'structure' as defined by the author on pages 3 and 4 are more generally included in one term 'Habit' or 'Form', the term 'structure' usually referring to X-ray structure or space lattice of a mineral. Table 3 should, therefore, be termed 'crystalline form' and Table 4 'Habit' respectively. Excepting for certain metallic minerals, colour is a variable factor in minerals and hence the different types of streaks could also have been included (p. 9). Instead of cataloguing the optical and mechanical parts of a petrological microscope (p. 12) a sketch of the petrological microscope with different parts labelled and an explanatory note on the parts, would have been better. Similarly sketches of the different optical figures would have been more helpful.

In the classification of mineral deposits (p. 20) 1, 2, 4, 5 and 6 are all magmatic deposits. To distinguish them the various stages of magmatic intrusion should be considered, *e.g.*, 1, is magmatic segregation and the rest come in the pegmatitic, pneumatolytic or hydrothermal stages. In giving the distribution tables for economic minerals in India the more important deposits which are being actually worked should be distinguished from less and insignificant deposits.

Other constructive suggestions could be offered, in particular for the section of petrology, and we hope that the author will consider all these when he brings out a second edition of this useful reference book. A stiff cover for the book would be welcome. The author deserves the gratitude of all students of geology for this useful compilation.

B. V. I.

SUPER-NORMAL FACTORS IN HUMAN PERSONALITY*

DR. ATREYA has departed from the usual routine in choosing a subject for his Presidential Address. The subject chosen, ought to be, rightly, of interest to all psychologists and other students of human nature. He makes a passionate plea for the correct understanding of what are usually known as super-normal phenomena. This, he believes, is necessary if one wants to avoid complete disaster of modern civilization.

He feels it a duty of modern psychologists to interest themselves in the study of super-normal facts of human experience. These super-normal facts are divided into: (1) Miraculous cures and super-normal control over the body, (2) Exteriorization of Motivity and Telekinetic Phenomena, (3) Apparitions, (4) The Aura and the Astral Body, (5) Super-normal Cognition, (6) Crystal-gazing, Automatic Writing and Speech, Dowsing, (7) Genius, Materialization, Ectoplasm, Paraffin Moulds and Fingerprints, (8) Transmediumship, and (9) Reminiscence of Past Life.

All the topics are dealt with in an interesting way. The author has tried to persuade the reader to accept these as facts, by adducing a number of facts as evidences. In most cases these evidences are taken from the writings of other persons interested in the topic. Though, ordinarily such a procedure is exact enough, in matters connected with super-normal phenomena where verifiability is extremely difficult if not rare, to base our conclusions on the assertions of others might be considered risky by the more orthodox sections amongst scientists. There is no doubt that some of the phenomena cited are genuine and serious-minded experimentalists like Rhine, are devoting time and energy for a proper understanding of them.

By far the most important chapter of the Address is the last one where the author speaks of the bearing of the super-normal facts of experience on the theory of human personality. Acceptance of the inevitable fact of Telepathy and a proper understanding of the operative laws—as Worcollier has tried to—will considerably change our conception of human personality and relationship. Mrs. Sidgewick long ago made a similar plea. If one has not been able to achieve much since then, it is not because of lack of interest on the part of psychologists. It is because of the subtle nature of the phenomena themselves and the extreme caution necessary before hazarding laws and rules operative in super-normal phenomena. But the task is urgent and a proper understanding of the phenomena might reveal truths on which depend human destiny.

Though one cannot fully subscribe to the author's views—which he sometimes modestly asserts—yet, Dr. Atreya has laid all the psychologists under a deep debt of gratitude by this well-written, thought-provoking and thorough address, on a subject which less brave souls would have hesitated to speak about.

N. S. N.

* Summary of the Presidential Address of the Section of Psychology and Educational Science, *The Indian Science Congress*, **1943**, delivered by the President Dr. B. L. Atreya, M.A., D.Litt.

ANNUAL REVIEW OF BIOCHEMISTRY

Annual Review of Biochemistry, Vol. XI. Edited by James Murrey Luck and J. H. C. Smith. (Annual Reviews, Inc., Stanford University P.O., California), 1942. Pp. x + 736. Price $5.00.

TWENTY-SIX reviews covering about six hundred and sixty pages comprise the volume. Some of the newer aspects of biochemistry so far not discussed in previous volumes are to be found, *e.g.*, the Chemistry of Visual Substances, Avian Biochemistry, Biochemistry of Teeth and Plant Tissue Cultures. Dubos has reviewed the subject of microbiology from the new standpoint of cell metabolism in relation to the anti-bacterial agents of synthetic, biological and microbial origins.

Special attention may be invited to Gyorgy's review on the Water-Soluble Vitamins to whose number new vitamins are being added year after year. The review commences with a pertinent discussion on the definition of a vitamin, and includes a critical appraisement of microbiological methods in the study and assay of vitamins. Those interested in the assay of Vitamins A and D will find the chapter on Fat-Soluble Vitamins by Morton, interesting and valuable. He invites attention to a new method of assaying D in liver oils; this involves a chromatographic adsorption of non-saponifiable matter from heptane solution on a column of "Hydraffin K_1"—an active carbon from Lurgi G.m.b.H. Frankfurt a.M. The chromatogram is developed and eluted with heptane and the vitamin determined spectrographically by means of the ultra-violet maximum at 265 $m\mu$.

Van Veen reviewing the subject of nutrition, has happily recognised the non-applicability of Western standards to nutrition problems arising in the tropics and in the Far East. He adds, "The reason for this is that these regions, which include such an extensive area of the earth's surface, differ considerably in climate, density of population, diet, nature of soil, etc. There are, however, certain circumstances which make it possible to speak about nutrition problems which most tropical countries and countries in the Far East have in common and which—at least in many respects—often differ from those in temperate regions, especially in North America and Europe." If nutrition workers will remember this in future, they will avoid the many pitfalls which their predecessors have encountered.

Mitchell's review on the metabolism of proteins and amino acids is extremely interesting and a valuable contribution. Discussing the theories of protein metabolism, he refers to the brilliant investigation of Schoenheimer and his collaborators, involving the employment of amino acids and other nitrogenous compounds containing strategically placed N^{15} isotope and deuterium. This experimental mode of attack has revealed that urinary creatinine is derived from tissue creatine. Further "the major mechanism for urea formation was proven to be the ornithine-arginine cycle, the conversion of phenyl alanine to tyrosine was found to occur readily in the body even in the presence of an excess of dietary tyrosine, the importance of glutamic and aspartic acids in transamination was established, the conversion of ornithine to proline and glutamic acids was shown to occur, and the anabolic utilisation of unnatural isomers by inversion to the natural form was demonstrated with *d* (+)-Leucine". The reviewer adds, "The most important discovery of the researches of Schoenheimer and his colleagues with labelled amino acids was the revelation of the existence of dynamic equilibrium between the tissues of the body and the surrounding nutrient media that had not previously been suspected".

Other reviews include Biological Oxidations and Reductions by E. G. Bull, X-ray studies of the Structure of Compounds of biochemical interest by M. L. Huggins, Hydrolytic Enzymes—non-proteolytic by D. Glick, the Chemistry of the Acylic Constituents of Natural Fats and Oils by T. P. Hilditch, the Chemistry of Steroids by C. W. Shappe, the Chemistry of the Proteins and Amino Acids by J. T. Edsall, Lignin by Hibbert, the Chemistry and Metabolism of the Compounds of Phosphorus by J. C. Sowden and H. O. L. Fischer, Carbohydrate Metabolism by M. Somogyi, Fat Metabolism by E. Chargaff, the Chemistry of the Harmones by J. J. Pfiffner and O. Kamm, the Clinical Aspects of Calcium and Phosphorus Metabolism by W. E. Cohn, E. T. Colm and J. C. Aub, the Chemistry of Muscle by G. A. Millikan, Animal Pigments by D. L. Drubkin, the Alkaloids by L. C. Craig, Mineral Nutrition of Plants by A. H. K. Petrie and Immunochemistry by J. R. Marrack. The volume is as usual provided with a very helpful author and subject index.

With this volume under review, the Annual Review of Biochemistry enters upon its second decade of distinguished service in promoting the advancement of every phase of Biochemistry. The last decade has been one of the most eventful periods in the history of biochemical research as revealed by a study of the series which has faithfully portrayed the progress year after year.

There is one aspect of service which such reviews can render and that is one which is not generally comprehended and appreciated. We refer to the dynamic part played by the reviews in inspiring new lines of attack, in stimulating original thoughts and in directing the course of research in fruitful channels. It is not easy to assess this role but it may be stated that the Reviews have played a definite part in this.

On the occasion of the commencement of the second decade, it is only appropriate to recall that it was the genius of Dr. Luck that first conceived the idea of these reviews and his robust and wholehearted drive established it as a permanent Institute. Biochemists the world over will join with us in expressing our grateful appreciation of his devoted labours in this direction.

CENTENARIES

Wallace, William (1768-1843)

WILLIAM WALLACE, a British mathematician, was born of a leather-manufacturer, 23 September 1768. Having served, as a boy, in a book-bindery and then in a printing office, he learned mathematics and classics by his own industry. In 1794 he became a mathematics teacher in Perth Academy and began contributing to the *Transactions of the Royal Society of Edinburgh*. His work attracted the notice of John Playfair who secured him a teaching post in the Royal Military College in 1803. In 1819 he succeeded to the professorship at Edinburgh.

Wallace was mainly responsible for the erection of the observatory at the Carlaton Hills and of a monument to Napier, the inventor of logarithms. He invented the eidograph and the chorograph.

Wallace died at Edinburgh, 28th April 1843.

Cartwright, Edmund (1743-1823)

EDMUND CARTWRIGHT, the inventor of the power loom, was born at Marnham, 24 April 1743. He entered Oxford at 14 and was enabled by a special act to take his degree before the prescribed age and was made a Fellow of Magdalen in 1764 and in 1779 he became rector of a provincial town.

In 1784, Cartwright paid a holiday visit to the spinning mills at Cromford. Soon after his return home, he constructed a power loom and took patent in 1785. In 1787, he set up a factory of his own at Doncaster to work with his power loom.

In 1782 Cartwright invented a wool-combing machine. It saved labour so much that some 15,000 wool-combers appealed to the Parliament for protection.

On the petition of fifty prominent Manchester firms, the Parliament granted him a sum of £10,000 in recognition of the services rendered by him to the nation by the invention of the power-loom.

Cartwright died at Hastings, 30 October 1823.

University Library,
Madras,
December 4, 1943.

S. R. RANGANATHAN.

SCIENCE NOTES AND NEWS

Preventive Methods for the Remission of Malaria.—The discovery that a deficiency in biotin, nature's most powerful vitamin, greatly increases the susceptibility to malaria and that an adequate amount of the vitamin will increase resistance to the infection, was reported this week in *Science*. Experiments on chickens and ducks, which led to the findings, are described by Dr. William Trager of the Princeton Station of the Rockefeller Institute for Medical Research.

The discovery clears up for the first time the long-standing mystery of why some individuals are more susceptible to malaria than others, and marks one of the very few instances in which a specific vitamin has been found to increase resistance to a specific disease—in this case, one that inflicts several hundred million people throughout the world. Thus there is opened for us a new avenue of approach for the prevention of malaria which promises to be of considerable value to our armed forces in lands where malaria is prevalent. Biotin is found in large amounts in egg yolks, liver, milk and, to a lesser degree, in a number of other foods.

Chickens and ducks, made biotin-deficient by being kept on an egg-white diet for two or three weeks, were subsequently inoculated with large doses of malaria parasites. They showed their peak in parasite numbers to be 50 to 100 per cent. higher than those shown by control animals, while among the biotin-deficient animals, the parasite numbers persisted at a high level several days longer and more animals died of malarial infection than among the controls.

"Certainly the results would indicate that biotin which is a substance of known chemical nature helps determine the degree of resistance of the host to an infection with malarial parasites. The results are also of interest since they provide an example, in addition to the very few thus far discovered, of specific relations between nutritional deficiency and susceptibility to an infectious disease."

A Cure for Many Diseases.—An article in the current issue of the *Lancet* by Professor and Mrs. Florey of Oxford, describing the first extensive trial of a new drug, Penicillin, may well prove to be a landmark in medical history, writes the medical correspondent of the *News Chronicle*.

Not only is Penicillin many hundred times more potent than the Sulphonamide drugs, like M and B 693, and Sulphathiazole, but it has also cured infections such as meningitis, staphylococcal and septicæmia in which the Sulphonamide drugs had proved useless.

In one remarkable instance an airman, who had such severe blood poisoning from staphylococci that his lungs were full of abscesses, made complete recovery.

A local application of Penicillin to the infected wounds has also proved most effective.

The drug is still quite unobtainable by the public. A tedious and lengthy process is necessary to make only very small quantities. It is to be hoped that further researches may result in larger supplies being produced synthetically and that no effort will be spared to make the benefits of this drug available to everyone.

The Use of Silica Gel as a Substitute for Agar in Culture Media: by C. G. Anderson and J. C. Macsween.—In view of the importance of the subject-matter, we reproduce below, in full, an extract from the *Journal of Pathology and Bacteriology*, Vol. 54, No. 4, October 1942:—

The use of silica gel to replace agar in media for the isolation of auto-trophic bacteria was introduced by Kuhne (1890) and developed by Winogradsky (1891) and Omelianski (1899). It has occasionally been recommended for more general use, for example, by Munch (1936), Wahl (1938), Clauberg (1941) and Sterges (1942). Usually rather elaborate dialysis procedures have been employed for removing excess of salts and for introducing the nutrient materials. The difficulty of sterilisation has been mentioned frequently. Autoclaving and steaming result in disruption of the gel unless special precautions as to composition, pH and other conditions are taken.

When it became desirable to grow *Bact. dycenteriœ* Shiga on a solid medium for the production of toxin without contamination by agar products the following method was adopted.

Commercial water glass (sodium silicate) is diluted with water to a specific gravity of 1·3. One volume of the solution is mixed with nine volumes of nutrient broth (or other appropriate medium) and 25 ml. of 0·04 per cent. bromothymol blue indicator added per litre. The solution is sterilised by filtration through Ford SB pads in a Seitz filter as soon as possible after mixing. A delay of even an hour or two considerably slows down the filtration, while standing for two to three days results in gel formation. The filtered broth-silicate mixture is filled into sterile containers, using a burette with a hooded jet. The pH of the medium is then adjusted by the addition of 8N or 4N phosphoric acid under sterile conditions. The strong acid is used for large volumes of medium, for example, 100 ml. in a Roux bottle, and 4N acid for small quantities for slopes or pouring plates. Gel formation occurs between pH 5 and 9, but considerably more rapidly on the alkaline side. The optimum appears to be about pH 7·2 (a very pale blue-green colour of the bromothymol blue), but it can be varied to suit the requirements of the organism under investigation. To bring the broth-silicate mixture to pH 7·2 requires a volume of 8N phosphoric acid approximately one-tenth that of the broth. Gel formation at this pH takes about two minutes, allowing ample time for sloping tubes or pouring plates. It is advisable to incubate plates or Roux bottles for 24 hours in an inverted position before use, in order to allow complete extrusion of fluid from the gel by syneresis. If this is not done the inoculum may be washed off or a spreading growth result. The extruded fluid can be removed in a sterile manner if desired, although it is not really necessary. This preliminary incubation also serves as a check on sterility.

The medium has been found to support the growth of the ordinary pathogens and saprophytes as effectively as an agar medium. Morphologically the organisms appear normal. In the case of Shiga's bacillus, toxin is produced, on autolysis, in as good yield as from organisms grown on ordinary media.

1. Clauberg, K. W., *Zbl. Bakt.*, *Abt. I*, *Orig.*, 1941, **147**, 75. 2. Kuhne, W., *Z. Biol.*, 1890, **27**, 172. 3. Munch, H., *Arch. Hyg. Bakt.* **117**, 129. 4. Omelianski, V., *Zbl. Bakt.*, *Abt. II*, 1899, **5**, 537. 5. Sterges, A. J., *J. Bact.*, 1942, **42**, 317. 6. Wahl, R., *Compt. rend. Soc. biol.*, 1938, **128**, 854. 7. Winogradsky, S., *Ann. Inst. Pasteur*, 1891, **5**, 92.

Kerst Induction Electron Accelerator or Betatron.—One of the major discoveries in the field of X-rays in recent years is the successful development of an induction electron accelerator or betatron. In a paper appearing in *Physical Review*, 1941, **60**, 47, Prof. Donald W. Kerst of the University of Illinois has described the principle and the constructional details of this new physical apparatus. It works on the same principle as the cyclotron. The electron-generator which is a doughnut-shaped glass vessel, is placed between two circular pole pieces of an A.C. electro-magnet. The electron beam emerging from the hot filament is accelerated during repeated revolutions in the magnetic field. At the end of the cycle, the high-speed electrons fall on a target giving rise to X-radiations. The velocity attained by the electrons is said to be the highest ever attained, being only 3/100 per cent. less than that of light. Prof. Kerst's first model had an output of nearly two million volts. In the treatment of malignant growth in human body, these high-voltage X-rays emerging from the electron tube have maximum effect about 1½" below the surface of the body and could, therefore, be used for such treatment without causing injury to the skin. C. S. V.

Gramicidin.—Within the last few years a number of bactericidal substances produced by soil bacteria have been investigated. Of these, certain substances, extracted by alcohol from gram-positive organisms, and especially gramicidin isolated by Dubos and his co-workers (Dubos, R. J., and Hotchkiss, R. D., *J. Exp. Med.*, 1941, 73, 629) appear to be the most important. These investigators found that extracts from cultures of certain soil bacteria and from similar organisms present in sewage, manure and cheese, could inhibit the growth of gram-positive organisms. The most important constituent of such cultures, gramicidin, is apparently a substance with remarkable properties. It is a polypeptide soluble in lipoid solvents, but insoluble in water, so that it has to be administered in suspensions. Unlike penicillin and the sulphonamides, its action is bactericidal rather than bacteriostatic. Against

certain organisms it produces its effect in quite high dilutions. This is observed when the experiment is carried out *in vitro* and is also seen in the living animal, especially when the organism used for inoculation is the pneumococcus. Unfortunately the toxicity of gramicidin injected into animals is comparatively high, and it is doubtful whether it is suitable for general administration. It may possibly be of value for local application, and good results have been reported in the treatment of mastitis in cows, following the injection into the udder of suspension of gramicidin.

Much further work will be done on chemotherapeutic substances produced by various kinds of bacteria, and it seems quite possible that discoveries of great therapeutic value may ultimately result from these investigations.

(Robson, J. M., *Chem. Products*, 1942, 6, 15.)

The U.S.S.R. in War-time.—The broadsheet *Soviet Planning in War-Time*, issued by P.E.P. (Political and Economic Planning) gives a useful objective account of the ways in which the Russian economy has advanced from one mobilised for war in 1941 to a battle economy, and of the general background of this economy. The machinery of Soviet planning functions through three main stages: first, a comprehensive survey of existing resources; secondly, the formulation of a plan, which is simply the laying down of a series of output programmes which must be carefully dovetailed into each other so that they are consistent; and, thirdly, a mechanism for checking their progress and for providing the elasticity necessary for periodic adjustments. This machinery was evolved over a considerable period of time, and the broadsheet gives a brief account of the purposes and achievements of the three Five-Year Plans. It was only during the second Five-Year Plan that the consumption of foodstuffs and living standards generally rose to any appreciable extent, but an important aspect of that period was the development, partly for strategic reasons, of industrial and raw material resources east of the Urals. Both the first and the second Five-Year Plans between them largely achieved their objectives of the creation of modern large-scale industry and a mechanised agriculture as the basis of raising living standards to a higher level and for national self-sufficiency in war-time.

The third Five-Year Plan provided for further increases in the output of industry and agriculture, but its most striking feature was the huge increase in the resources devoted to defence. Moreover, the whole organization of Russian economic life, with its machinery for central planning and its high degree of military preparedness, makes for a greater degree of continuity between peace and war economies than in any other country except Germany. Owing to the absence of excess capacity, the war sector from the outset had to be expanded at the expense of the peace sector of the economy. The producers' goods industries were, so far as possible, adapted to war production and the output of these industries was reduced. Agriculture was seriously affected by labour shortage due to mobilization, which was only in part made up by urban workers and spare-time labour. Excess purchasing power seems to have been skimmed chiefly by increased subscription to State loans. To effect the heavy losses in production resulting from Nazi occupation of European Russia, great efforts, apart from the evacuation of industrial plant and rolling stock, have been made to increase the absolute absorptive capacity of the Ural and Asiatic regions. New sources of raw materials are being exploited, new power stations established, new coal pits sunk, and new oil-wells drilled. New plantations of rubber-bearing plants, of sugar beet, etc., have been developed, and new substitutes and methods are being employed for the manufacture of sugar and soap. In all this, scientific workers have played a great part, as well as in the simplification and rationalization of many technical processes.

—(*Nature*, 1943, **151**, 50.)

MAGNETIC NOTES

Magnetic conditions during March 1943 were almost as in the previous month. There were 8 *quiet* days, 20 days of *slight* disturbance and 3 of *moderate* disturbance as against 12 quiet days, 15 days of slight, 3 of moderate and 1 of great disturbance during the same month last year.

The quietest day during March 1943 was the 15th, while the 29th was the day of largest disturbance.

The individual days were classified as shown below:—

Quiet Days	Disturbed days	
	Slight	Moderate
9, 10, 13, 15, 18, 25, 26, 28.	1, 3-8, 11. 12, 14, 17, 19-24, 27, 30, 31.	2, 16, 29.

One moderate storm of short duration with a gradual commencement was recorded in March 1943, while two magnetic storms, one of moderate and one of great intensity were recorded during the same month last year.

The mean character figure for the month of March 1943 was 0·84 as against 0·74 for March 1942.

M. V. SIVARAMAKRISHNAN.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory, Bombay, during the month of March 1943, there were six of slight and three of moderate intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin I.S.T.	Epicentral distance from Bombay	Remarks
		H. M.	(Miles)	
7	Moderate	09 32	5300	Epicentral region near Aleutian Islands.
9	Moderate	16 19	7870	Epicentral region near New Zealand (?)
10	Slight	14 45	7850	..
14	Slight	18 29	4490	..
14	Slight	19 13	4490	..
15	Slight	08 55	7140	..
15	Slight	11 18	4670	..
22	Moderate	03 06	5500	..
27	Slight	00 08	7910	..

ANNOUNCEMENT

University of Travancore.—*The Subramonya Karayalar Lecturership*: Applications are invited for the award of the Subramonya Karayalar Lecturership under the University.

The subject of the Lecture shall relate to some scientific problem of economic value.

The Lecturer selected will have to deliver at Trivandrum a course of not less than four lectures relating to some scientific problem of economic value within the course of two years from the date of this notification.

The Lecturer will be paid an honorarium of Rs. 400 only. A grant not exceeding Rs. 100 may be made by the Syndicate towards incidental expenses in connection with the lectures, if necessary.

Applications must reach the Registrar, University Buildings, Trivandrum, on or before the 1st *July* 1943.

Imperial Dairy Research Institute.—The Imperial Dairy Research Institute, Bangalore, has been authorised by the Government of India to entertain Honorary Research Workers, who are graduates of Indian and European Universities and who are desirous of carrying out research work at the Institute. Such candidates as are suitable and well qualified for dealing with a problem within the purview of the work and activities of the Institute will be selected. The number of workers to be admitted will be limited to two at present and their period of research work will not ordinarily exceed one year. The workers will be exempt from payment of any fees for the period of the research work; but they will have to make their own arrangements for board and lodging.

We acknowledge with thanks the receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 91, No. 4628.

"Biological Reviews," Vol. 18, No. 1.

"Agricultural Gazette of New South Wales," Vol. 54, Pt. 1.

"Biochemical Journal," Vol. 34, No. 12; and Vol. 36, Nos. 7-12.

"Journal of the Indian Chemical Society," Vol. 20, No. 1.

"Indian Farming," Vol. 3, No. 12; and Vol. 4, No. 1.

"Indian Forester," Vol. 69, No. 4.

"Genetics," Vol. 28, No. 1.

"Bulletin of the Indian Central Jute Committee," Vol. 5, No. 12.

"Transactions of the Mining, Geological and Metallurgical Institute of India," Vol. 38, Pt. 2.

"Indian Medical Gazette," Vol. 78, No. 3.

"The Review of Applied Mycology," Vol. 21, Nos. 11 and 12.

"Bulletin of the American Meteorological Society," Vol. 23, No. 8.

"Nature," Vol. 150, No. 3815; and Vol. 151, Nos. 3818 and 3819.

"American Museum of Natural History," Vol. 50, No. 3; and Vol. 51, No. 1.

"Canadian Journal of Research," Vol. 20, Nos. 10 and 11.

"Science," Vol. 96, No. 2504.

"Science and Culture," Vol. 8, No. 10.

"Sky," Vol. 2, No. 3.

"Indian Trade Journal," Vol. 148, Nos. 1912-18; and Vol. 149, Nos. 1919-20.

BOOKS

The Life of Sir J. J. Thomson. By Lord Rayleigh. (Cambridge University Press, London), 1942. Pp. x + 299. Price 18*sh.*

Switchgear Practice. By Arthur Arnold. (Chapman & Hall, London), 1942. Pp. iv + 238. Price 22*sh.*

Electric Power System Control, Vol. XI. By H. P. Young. (Chapman & Hall, London), 1942. Pp. xii + 319. Price 25*sh.*

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STORAGE OF FOOD GRAINS

THE recent establishment of a separate department of food, with a budget of twenty crores of rupees, by the Central Government has been part of a vast network of developmental activities in India, as in other allied countries, inaugurated to meet the complex and emergency conditions created by the War. It bears ample testimony to the realisation of the tremendous importance of food supply in a country of such vastness, variety and distances as India. The large body of the defence personnel and the huge civilian population in the country, both together, demand an extremely wide and well-organised and efficient system of adequate food supply. At a time when war has come to the very door-steps of the citizens, and when, practically, every one, from the office clerk to the munition factory worker, is engaged in war effort, and when high civilian morale is considered to be as important as the morale of the fighting forces, the question of an adequate supply and equitable distribution of food necessarily assumes infinite importance.

Nor is the matter of proper storage of food grains and other products meant for consumption any less important at a time like the present. Few people realise that the State and its citizens, as well as the fighting forces, have to contend with quite a vicous and powerful army of sabotaeurs, where preservation of food grains is concerned. It is estimated that the direct and indirect loss sustained every year in India in the sphere of staple food commodities before and after harvest on account of the destructive activities of a variety of insects alone, easily mounts up to two thousand crores of rupees; and a fair proportion of this loss has been attributed to the havoc played by that special group of insects that infest food grains and other related products in storage. While, in normal times, the very inadequate or even entire lack of appreciation of this colossal destruction of vital food materials by insects could, perhaps, be somewhat excusable, in times of war, any such tendency on the part, even of the individual citizen, and the State in particular, would be utterly suicidal.

Directly, the insects excavate and feed on or otherwise destroy the vital contents of the grains, besides filling their cavities and the store in general, with their fæces and the dead; indirectly, as a result of their normal and vital life-processes of

respiration and metabolism, the internal atmosphere of the storage receptacles, etc., is rendered so excessively humid and warm as to cause the growth of harmful fungi and the starting of fermentation; the grains, being themselves alive and, in a state of active respiration, further complicate and worsen matters. Where insect-infested grains remain in storage for long periods the cumulative effect is rarely less than total devastation; for, even that portion of the food grains that escape the direct attentions of the insect populations, is ultimately rendered unfit for human consumption, having been so badly affected by the evil effects of fermentation.

Man was faced with the problem of securing a proper storage of his food grains, the moment he thought of harvesting and conserving his crops. Various methods of storage have since been in vogue in different parts of the world with the common object of preserving the grains from the destructive activities of certain kinds of predatory insects and mites which thrive and breed in food grains during storage. A review of the methods of grain storage practised over considerably long periods reveals that they are too few and circumscribed in character. But some of the age-old methods, though very simple and somewhat crude, are really very ingenious and suggestive and serve the purpose for which they are applied fairly well. Of comparatively recent introduction are other methods that tend towards much complexity and specialisation, and lie rather beyond the scope of the average agriculturist, the grain merchant or the housewife, especially in India; but they may be easily adapted to the special and emergent conditions brought about by the war, through the agency of the Central and the Provincial Governments in the country.

It should be extremely interesting and instructive to examine critically the several methods of storage of food grains already in vogue in this country. Practically all these are age-old and time-honoured methods, having their good as well as bad points. And, having regard to the economic conditions of the peoples of India, they appear to be almost ideal; but, it should be admitted that they are so, not from the point of view of efficiency but the standpoint of easy adoption and management; the desirability or the possibility of improving upon them, therefore, does exist.

It is difficult within the limits of this note to go through all the several methods pointing out in detail their merits and demerits and considering ways and means of improvement. A few of the more important ones could, however, be touched upon briefly. The earthen pots, bins and baskets made of bamboo, plaited straw and fibre, gunny bags and underground cellars of different shapes and sizes, used as containers for storing grains—cereals and pulses—and other forms of food materials in rural and urban parts of the country are all fairly well known to everyone. These containers would not have been accepted generation after generation, if they had not their very good points about them. The very shape of the pots and bins—with narrow necks (mouths kept sealed up) and wide and oblong or spherical bodies, some of them with small valve-like lateral outlets, somewhere towards the bottom, is admirably well suited for the purpose of preventing serious damage by insects. The tightly-packed grains inside leave little or no room for movement or other activities of the insects. The practice in some localities of mixing the grains with extraneous matter like sand, husk or ashes, further helps in blocking up interspaces between the grains. Bags and sacks made of gunny, plaited straw and fibre, and with tightly-packed grains to the brim and stacked one on top of another, usually prove fairly efficient in keeping insect damage to a minimum, as the great pressure thus exerted on the pile of bags, effects a further and closer packing of the medium, thereby reducing the moving space for the insects. Cement concrete cellars, above or underground, rendered perfectly air-tight and dry, with a tight fitting and carefully operated trap-door, also serve to an appreciable extent to keep away most of the insect pests. The practice of smearing the top layer of grains (pulses) with castor oil, when baskets and bins are employed for storage, has the particular advantage of preventing the successful hatching of the grubs and later, boring into the grains; the presence of the oil renders the hold on the grains necessary for excavating impossible. One of the most interesting methods of control practised in certain rural areas and now apparently

given up, consisted in the use of a small pellet of mercury in a shallow cup placed in a corner of the storage receptacle on the topmost layer of the grain. Mercury is sometimes used for preserving certain kinds of pickles safe from "worms". One of the most common preliminary treatments of the grain before storage practised even by the less advanced of village folk is the sun-drying of the grains spread in a thin layer for varied lengths of time; this has been found to constitute one of the most natural, simple and efficient methods of rendering the grains sufficiently dry for storage and of ridding them of the associated insects that might have been carried over into the grain from the field, the threshing grounds or during transit.

This brief review of some of the existing methods leaves one to wonder why, in actual practice, so much of damage and loss is still being caused by insects during storage. The reason lies in the circumstance that necessary attention to detail is not paid in the practice and application of the methods. Often, the methods are not described in sufficient detail and with adequate precision to bring the method under scientific control. Efforts to eliminate these defects to a large extent are being made and a few improvements have been effectively introduced and successfully demonstrated. But the indifference and the conservative attitude on the part of the people expected to adopt these methods, has continued. This is well illustrated by the fact that the recommendation based on the discovery that a top dressing of the mass of grain under storage with a two-inch layer of sand effectively prevents infestation, has not been generally adopted in spite of its obvious simplicity and proven efficiency.

There is, however, considerable scope for further research in the direction of evolving other simple, inexpensive and effective methods and in improving upon the old ones. A few such lines of work may, perhaps, be touched upon at this stage. While the shape of the bins and baskets used for storage all over the country and the constructional materials from which they are made are undoubtedly ideal for Indian conditions, specially in rural parts, the mixture of mud and dung used to smear the outer surface urgently requires to be substituted by some equally porous but far less vulnerable material, exhibiting little tendency to crack or peal off with age. Bamboo and fibre bins, which are highly susceptible to termite attack should be rendered termite-proof. The usual practice of keeping the receptacles elevated on stone and other kinds of supports does not always leave them immune from the attentions of this dangerous pest. The bags or sacks made of jute, fibre and plaited straw generally have a large surface exposed and invite insect invaders; this circumstance offers the possibility of employing some inexpensive, efficient and innocuous insecticide in the form of fine dusts or sprays to cover the exposed portion of the bags at regular intervals. This treatment will serve to repel or kill the invading insects. In the case of cellars or pits full with grains, our knowledge is very meagre with regard to the environmental conditions prevailing there. The effect of these conditions on the quality of the grain has not been carefully determined. The nature and extent of infestation in them more than in other methods of storage, largely depend upon the factors of temperature and humidity. A critical study of the interplay of these two factors inside them, though extremely difficult to conduct is, nevertheless, essential if grains stored therein for long periods, have to be preserved from insect damage and in a perfectly fit condition for human consumption and for seed propagation. The reputed property of mercury in preventing insect infestation needs to be carefully and scientifically examined. A certain amount of work has been carried out in India in recent years in this connection but unfortunately it did not progress sufficiently far. Not only the pure metal but even tin amalgam was found to have a decidedly deleterious effect, particularly on the eggs of certain species of insects infesting grains. While the how and why and numerous other details of the peculiar influence of mercury on insect eggs would, undoubtedly, form most fascinating lines of study, the investigation of the practical utility of the method applied on a large scale, is one that could be taken up with advantage.

The more modern and specialised methods of controlling the grain pests, recently evolved by research, may now be considered at some length. The practice of subjecting infested grains and other food

products to the action of poisonous fumes is prevalent in other countries, particularly in the United States of America. The practice of fumigation on a large scale being a highly technical process, is naturally entrusted to qualified chemical engineers and others specially trained for the purpose. Where food grains and other products meant for consumption are concerned, the method assumes special importance and special precautions become necessary. The rates of respiration and metabolism of the infesting insects have a direct bearing on the efficiency of fumigation. Attention should be paid to the residual fumigant whose quantity is likely to vary with different kinds of food materials, and to the most effective method by which the residue can be successfully eliminated or neutralised. It is generally recognised that fumigation is only rarely resorted to for purposes of ridding food-stuffs of insect infection even in countries outside India, because of lack of adequate knowledge with respect to the food-worthiness of the grains fumigated by hydrogen cyanide and carbon disulphide. It has been established that an auxiliary fumigant like carbon dioxide enhances the effect of the principal fumigant like hydrogen cyanide by causing the insects to keep open their spiracles or breathing apertures; but no attempts appear to have been made to examine whether carbon dioxide does not concomitantly help in the absorption of larger amounts of the fumigant by the food grains themselves, in which case the problem of residual fumigants becomes much more serious. In the present uncertain and unsatisfactory state of our knowledge, it would appear safer to concur with the view that, in the task of preserving food grains, simple and safe methods alone are to be recommended and adopted until, at least, the most correct form of fumigation practice is evolved and established to be perfectly safe from the consumers' point of view.

Other substances like methyl-bromide and "Chlorosol" (a mixture of ethylene dichloride and carbon tetrachloride) for example, have, of late, been widely recommended as decidedly safer and equally effective. It is high time that competent authorities under the auspices of the Department of Food took up a comprehensive investigation of the practicability of the use of these and other types of "Safe" fumigants. Under the stress of the existing emergent conditions in India, the need for storing large quantities of food grains in a large number of localities all over the country, has definitely arisen; the time is, therefore, ripe for planning and implementing.

Processes like dry-heating and cold-storage have been employed in prevention of insect infestation of food-stuffs. These physical control measures also deserve to be considered very seriously, in so far as they are perfectly "safe" for the consumer. No expense can be too high in the matter of setting up and operating the necessary heating plants and cold stores, at a time like the present.

If the country should reap the fullest benefit from the creation of the Department of Food with its princely budget, the functions assigned to the Department should include the task of advising and guiding the large body of private people, the grain merchant and the individual citizen, in the matter of combating insect enemies effectively. This task can be performed only by technically trained men. The best course to adopt in this connection appears to be to employ sufficient numbers of such men to work under the several Regional Food Commissioners who have recently entered on their duties and have now been touring in different parts of the country. In addition, a Central Research Committee or several Regional Committees of Scientists, including entomologists, chemical engineers, biochemists and others, may be set up with a view to plan and investigate urgent aspects of problems of proper storage and treatment of food grains, with the help of a body of qualified scientific workers. Food supply in India at the present juncture is second to no other problem in importance and no effort should be spared to see that the populations are well and adequately fed.

CRUMB STRUCTURE AND SOIL FERTILITY

BY

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ALL soil research aims, ultimately, at the production of larger and better crops for the better nutrition of our human and animal population. It is, therefore, natural that early efforts were directed towards assessing the fertility of soils through a study of their chemical composition and the availability of plant foods contained in them. The limitations of such methods were soon felt when it was experienced that soils having an adequate mineral content can yet be infertile and that soils apparently similar in regard to their chemical composition and mechanical analysis can show wide differences in yielding capacity. It was then that the importance of air and water for crop growth was adequately realised. Great strides have since been made in our knowledge concerning the physical properties of the colloidal material in the soil. But we have not, as yet, evolved a satisfactory method for giving quantitative characterization to the physical condition of the soil, especially in its natural field state. It may, nevertheless, be stated that so many aspects of soil physics, particularly those having a bearing on some relation between soil air and soil water, are intimately connected with the field structure of soils that studies on the degree of aggregation and the stability of aggregates have contributed largely to a fuller understanding of the processes controlling soil fertility. This emphasis on the structure of soils as a vital factor in their evolution or degradation is, undoubtedly, a great improvement on the older view which merely stated that the soil was deficient in this or that nutrient and that something must be done to restore its level or maintain its supply.

STRUCTURE DEFINED

Structure is a term expressing the arrangement of the individual grains and aggregates that make up the soil mass. The individual grains are the mechanical or textural separates such as sand, silt and clay and are, therefore, the primary soil particles while the aggregates consist of an intimate grouping of a number of primary particles into a secondary unit. The structure of any particular horizon of a soil profile as it appears to the eye of the soil morphologist may be considered as the *macro*-structure of the soil in this layer and refers to the natural arrangement of the soil when in place and undisturbed. Based on the size, shape and character of the faces and edges of these aggregates, terms such as 'nutty', 'mealy' 'granular', 'prismatic', 'columnar', 'platy', 'honey-comb', etc., are used to distinguish between the principal types of field structure[1-3]. Another classification of structure takes into account the structural arrangement of the primary and secondary particles, both in themselves and in a mixture of the two[4]. Several other structural groupings have been suggested such as those based on the type of pore space and the nature of the binding material that is responsible for aggregate formation[5-7]. Agriculturally, however, the kind of structure that is important in its effects, both direct and indirect, upon the soil as a plant habitat is the degree of aggregate formation which resists, under ordinary conditions, the dispersing action of water or beating rain. Aggregation of soil particles into crumbs or granules is the only structure having any practical value and the only one the formation of which has been studied in any detail.

TILTH OF SOILS

By tilth, we understand, ordinarily, the pulverulent condition of the soil which results from successful tillage. A good tilth is a condition which the farmer tries to produce and maintain, when produced, so that it is most suited to the growth of plants. This condition can be recognized in the field by an experienced farmer. Unfortunately, there is, as yet, no single method by which it can be measured quantitatively, for it is the result of many factors which have not been isolated and analysed, but one of the fundamental factors is undoubtedly a good crumb structure. Tilth is closely related to this structure or aggregate formation since both are associated with the presence of

colloidal material. Soils devoid of colloids have what is known as single-grain structure, each grain acting as a unit and no compound particles being present. Because of the size of the grains, the tilth of sandy soils is seldom bad. They are well drained, but of course lack the capacity to store moisture or retain plant foods, especially in tropical tracts. Soils containing varying amounts of colloids, on the other hand, present a rather serious problem. The individual grains are so small that if they are forced into a position of close packing, either by mechanical pressure or by the beating action of rain, they become exceedingly hard and impermeable to both air and water. Hence, soils containing appreciable amounts of colloids and with single-grain structure, are the most difficult to manage. Soil husbandry should, therefore, aim at the building up of stable aggregates or crumbs from these single grains.

Structure and Air-Water Relations

For healthy plant growth, the plants must have a continuous supply of soil moisture which does not reach the two extremes of drought and waterlogging. For this condition, two properties of the soil are of great importance: (*a*) the ease with which excess of watter can drain away from a soil under gravity, and (*b*) the amount of water the soil can hold against gravity. These needs are satisfied by the soil having a suitable distribution of pores[8]. If all the pores are large, as in coarse sand, water will drain away freely and air will have easy access to all parts, but if the pores are small, as in silt or unflocculated clays, water will be held in them against gravity and air will enter with great difficulty and the plant will die of asphyxiation. The ideal soil has such a pore size distribution that there are sufficient large pores or *macropores* for adequate gaseous exchange to take place between the soil air and the atmosphere and sufficient small pores or *micropores* for the soil to hold a reasonable amount of water against drainage for the utilization of plants[9]. This ideal condition of the soil is in part dependent upon the size and arrangement of the soil particles and is mainly controlled by crumb or aggregate structure. In an aggregated soil, the pore space is discontinuous, for the fine pores inside the individual aggregates are usually much finer than those between the aggregates. These pockets of fine pores inside each aggregate act as water reservoirs surrounded by large channels down which surplus water can drain away and so facilitate gaseous exchange between the soil air and the atmosphere.

Flocculation *vs.* Aggregation

Since structure is associated with the colloidal fraction of the soil and since compound particle formation of colloidal materials is usually referred to as flocculation, early students have attempted to approach the problem of soil structure or formation of soil granules by a study of the flocculation of clay soils. While, however, there are instances where mere flocculation of puddled soils have been followed by increased productivity, there is a vast difference between flocculation from the purely colloidal point of view and aggregation from the standpoint of structure. Chiefly, a floccule is stable only as long as the flocculating agent is present whereas stable aggregates are held together by a cementation of the flocculated particles. It is possible that flocculation is an essential first step in the granulation process but there is no doubt that granulation is much more than flocculation, involving as it does a combination of different factors.

Hypothesis of Crumb Formation

The mechanism of the formation of the soil aggregates is one of the most important but hitherto least understood phases of the soil structure problem. The cause of granulation has been variously attributed to the water film, the exchangeable cations, the organic matter, the inorganic colloids of the soil, as also the natural processes of heating and wetting[10]. But, it would appear that the cementation of clay particles at low moisture contents is probably the most important mechanism enabling mineral soils to form crumbs[11].

Crumb and Clod Structure

The difference between the crumb structure and clod structure of a soil is not yet understood, nor has it yet been possible to distinguish them on purely quantitative grounds. It has been assumed that clod structure is produced by purely mechanical means such as cultivation and can be altered at will by such means whereas crumb structure is an inherent property of the soil displayed when conditions are suitable[12].

By ploughing and cultivating a clay soil when wet, huge clods can easily be produced. If these clods are now subjected to a hard frost after the thaw, the clods will have fallen down to small, very stable crumbs so that the land will have lost its clod structure and gained a crumb structure through the agency of the frost[13]. If, on the other hand, these wet clods are dried, they will form hard lumps very resistant to cultivation. So far, the distinction between clod and crumb structure is clear. But if these clods are rewetted under suitable conditions and then carefully cultivated, they will fall down to smaller aggregates and, by continued suitable wetting, drying and cultivation, aggregates of any size can be produced. These aggregates can only be formed by the agency of wetting and drying, cultivation merely hastening the breakdown into suitable aggregates. Again, if the soil were originally ploughed under appropriate conditions, it would break into quite definite aggregates as it was turned in the furrow. This example shows that it is rather difficult to distinguish strictly between crumbs and clods.

The Stability of Structure

Crumbs may have two types of instability: (1) mechanically weak, and (2) unstable in water. If the soil clod does not contain sufficient colloidal material, the crumbs or clods formed in the soil will be mechanically weak and break down very easily to dust by cultivation operations, by the erosive action of the wind or by mechanical shattering through the action of falling rain drops. The last effect is well illustrated by the capping which heavy rain causes on some types of soils. Water-instability of crumbs is in part due to physico-chemical causes. Thus, if the clay forming the crumbs contains much replaceable sodium, the crumbs will be mechanically strong when dry, but will disintegrate when wetted with water, due to the weakening of the cohesion between the individual clay particles forming the crumb. This type of instability often occurs in arid regions, particularly when subjected to irrigation and has caused grave agricultural damage to large tracts of irrigated land.

The water-stability of the aggregates is of the utmost importance in promoting and preserving good structural conditions in the soil. Water may cause a breakdown or deterioration of the aggregates through the process of swelling and 'exploding' of the entrapped air (referred to later), or by mechanical action as with beating rain. The impact of falling rain will have a dispersing action on the aggregation of an exposed soil. These dispersed particles will then be carried into the soil pores causing compaction.

Aggregate Analysis

Aggregate analysis of the soil measures the relative distribution of the various sizes of aggregates and permits a calculation of the percentage aggregation of the finer mechanical separates. Such an expression is really an index of structure though, of course, it does not characterize the type of structure. A large number of methods of aggregate analysis have been proposed and used. In general, three techniques are employed to accomplish such an analysis. They are: wet and dry sieving, elutriation and sedimentation. Russell and Tamhane[12] have recently reviewed the different methods and their limitations. According to them, the aggregate analysis of the soil should be carried out under two conditions of wetting: (1) a slow wetting of the air-dry soil, when the minimum break-up of the larger aggregates takes place and which may represent the inherent water-stable aggregation of the soil, and (2) a rapid wetting of the air-dry soil, which causes a maximum break-up of the larger aggregates and may give the absolute water-stable aggregates. It would, however, appear essential that for obtaining a true picture of the structural capacity of field soils, the samples should not be completely dried or stored for long before making an aggregate analysis.

In the expression of results, the percentage of aggregates greater than 0·05 mm. in diameter has been used to characterize the "state of aggregation" of the soil[14, 15]. This lower limit has been chosen on the basis of the fact that the curves for the aggregate and mechanical analyses intercept near this point, which makes it possible to determine aggregates smaller than 0·05 mm. from the two curves[16,17].

Processes Contributing to Crumb Structure

Inasmuch as the properties of the soil as regards moisture, aeration and heat and, especially, permeability, water capacity and the degree of water penetrability are all

greatly dependent upon a good crumb structure, one of the primary functions of soil husbandry will be to create and maintain, when created, a good soil tilth. Two soil properties are important in this connection: (1) the ease with which a soil will form crumbs, and (2) the stability of the crumb structure when formed. Very little is known about the factors responsible for the ease of crumb formation in the soil though, admittedly, soil-forming climatic factors play an important part. Aggregate analysis of a large number of different soils are available which have yielded significant data for a correlation between climate and aggregation[18].

Organic Matter.—Foremost among the other factors contributing to aggregation comes organic matter. It is common knowledge that organic matter serves to aid aggregation in soils. The method of pretreatment with hydrogen peroxide before dispersing soils for mechanical analysis serves to get over the cementing action of organic matter. The exact mechanism of this cementing action of organic matter is little understood. The majority of evidence would appear to point to a kind of adsorption of the humus by the inorganic soil colloids, this adsorption being accompanied by a dehydration which brings about a stable union between the inorganic and organic materials[19-21].

It is not the organic matter itself so much as its decomposition that is important in structure formation[22]. The more rapid the decomposition, the better is the structure[10]. Decomposition of cellulosic materials, such as that resulting from the incorporation of straw into the soil, is especially attended by a marked improvement in structure even though the process of decomposition is very slow. Autolytic products, synthesized by micro-organisms, have a strong cementing action on the soil colloids. It has been suggested that mucus may be the most effective cementing agent[23, 24].

The fertility of humus-rich soils is well known. Indeed, humus is the thing which "makes all the difference between the soil and a mere geological deposit"[25]. It is generally held that every soil, depending on a number of completely interlocked factors, mostly climatic, has more or less definite organic matter level and that, therefore, it is hardly worthwhile to attempt a maintenance of the soil organic matter above certain percentages[26-31]. Recent evidence at Indore would point out, however, that it is possible, by continuous application of bulky organic manures over a period of some years, to raise appreciably the organic matter status of soils as compared to untreated plots; such treated plots are also very high-yielding and possess distinctly better crumb structure[32]. It is, therefore, desirable to carry out tests, under a variety of conditions, whether organic matter content of soils can be built up consistently with economic attainment of high yields.

Crop Effects.—With regard to structure in relation to the growing crops, Russian scientists have studied in considerable detail the effect of different crops on the deterioration and regeneration of soil aggregation[19, 33-35]. Of especial significance has been the result of the relations of grassland systems to soil structure; stable structure is best achieved by temporary ley or grass vegetation[33, 36, 37]. The use of elephant grass in this connection has been described by many workers and found to be of value under East African conditions[38-40]. The dawning recognition of the importance of grass in maintaining a high level of fertility in humid regions is paralleled in semi-arid regions by the recognition of its value in preventing erosion both by affording a dense vegetation cover and by providing a structure which resists erosion when the land is subsequently ploughed. Here, in India, ley farming has not gained any recognition in spite of its importance both in soil rejuvenation and from the point of view of fodder production.

Apart from the particular effect of grassland on soil structure, the mechanism of which is as yet not well understood, all growing crops can affect the structure of soil both indirectly and directly. The indirect effects result from the changes in granulation caused by the increased organic matter produced by plant growth. The direct effects are: "canopy" protection[41] and root influences. The first of these relates to the protection afforded by the leaves and stems against the impact of rain drops by preventing dispersion of the soil. This influence is obviously more effective the denser the foliage and the more rapid the rate at which the protective cover is established. With regard to the influences of root activity on soil structure, we cannot as yet distinguish between the aggregation effects of root pressure referred to later and the binding qualities of root hairs, the produc-

tion of organic matter, moisture changes resulting from water absorption by the roots, or any possible root excretions. It is quite possible that all these factors operate together in developing granulation and porosity through root influences.

Alternate Wetting and Drying.—Next to organic matter and, from the point of view of natural agencies, even more important in influencing aggregation in soils, is the effect of alternate drying and wetting. Experiments have shown that drying or dehydration of the soil colloids causes a shrinkage of the soil mass and a cementation of clay particles. This dehydration cannot obviously be uniform as unequal strains will arise tending thereby to form clods. When these clods, formed as a result of drying, are wetted slowly, there is a rapid imbibition of water causing unequal swelling throughout the clod and producing thereby fracturation and fragmentation along the cleavage planes[42]. Another, but less well recognized process that follows the sorption of water into the capillaries, results in a compression of the air spaces and, finally, in a "virtual explosion within the clod" as the pressure of the occluded air exceeds the cohesion of the particles[43, 44]. The unequal strain and stress set up by the shrinkage and swelling together with the disruptive action, on wetting, of air entrapped in the pores cause a granulating action on the soil colloids.

Alternate swelling and shrinkage of the soil colloids are also likely to result from pressure effects such as those following the penetration of crop roots or burrowing animals into soil[45, 46]. Due to this pressure, the cementing influences of the water films are probably rendered more effective and the colloidal particles themselves are brought into more intimate contact with each other. The result is, in a soil of good structure, channels left by decaying roots or made by burrowing animals will not collapse but will remain to act as ventilating shafts.

Russian work[47-49] has shown that stable artificial structures can be induced in powdered chernozems and solonchaks by subjecting the soils to mechanical pressure at definite moisture contents depending on the soil properties. The possibility of devising cultivation implements which will perform in the field the mechanical operations which have been shown to produce stable structures in the laboratory requires yet to be explored fully.

It is not, however, always that pressure effects are favourable for structural development. For instance, we know that trampling or excessive cultivation operations, especially on a moist soil, is followed by a deterioration in structure. No quantitative information on the optimum moisture content of soils when pressure effects are most favourable is available and our knowledge of the exact manner in which pressure acts on structure formation is, therefore, difficult to evaluate.

Effects of Cultivation and Tillage.—Culturally, aggregation may be affected in a variety of ways. It is well known that cultivated soils are less granular than the corresponding virgin areas[50]. Tillage affects structure as a result of decreased organic matter production, increased organic matter decomposition, increased leaching, the impact of rain drops on the exposed soil and the mechanical manipulation of tillage implements.

When new land is broken for cultivation, great care is needed to work the soil at proper moisture content. Empirically, the farmer knows that the simplest test in order to determine if the land is fit to plough is to collect some soil just below half the depth at which the plough will work. If it is somewhat difficult to work the soil into a ball in the hand, and, on crushing, the ball breaks into several pieces, conditions are ideal. It is, however, an observed fact that a perfect structure, similar to that of the undisturbed virgin land, cannot be obtained though a structure sufficiently good to meet the demands of a high-yielding crop can usually be maintained.

The importance of working a land at the correct moisture content will be obvious when it is realised that a land badly tilled can show evidence of both waterlogging and drought at the same time. Tillage operations may have varied effects upon soil structure depending upon the nature of the implement and the moisture content at manipulation[10].

Modern science has shown that cultivation operations have only a minor influence on the moisture regime of the soil[51]. In consequence, much of the traditional views on this subject have to be abandoned or recast. At Indore, experiments on shallow *vs.* deep interculture carried out over a number of years have shown that shallow interculture just sufficient to keep down the worst weeds has yielded best and that the adverse effects of excessive interculture are due to

loss in structure resulting from constant trampling over the soil.[52] It has been shown, similarly, that preparatory cultivation on the black soils of India[53, 54] and in the Sudan[55] is superfluous and may, at times, be decidedly harmful[56]. Even in temperate and cooler regions, the effect of the traditional thorough cultivation has begun to be doubted[57].

Cation Effects.—Much work has been done on the dispersing action of different cations on the soil colloids. Of practical importance are the effects due to sodium and calcium. The poor structural qualities of alkali soils have been demonstrated more or less conclusively as due to a high concentration of sodium in the exchange complex of the soil. It is equally well recognized that soils in poor physical condition can be restored to good tilth if the sodium ion is replaced by calcium ion. These facts along with laboratory observations that clay suspensions can be flocculated by calcium salts, have led to the widely accepted view-point that the beneficial effects of lime are due to its ability to flocculate the soil colloids. But experimental evidence upon the effect of calcium ion on the physical properties of the inorganic soil colloidal fraction does not altogether support the view that calcium favours aggregate formation. Thus, it has been found that granulation is not correlated with the degree of saturation of the soil with calcium and that the calcium ion is in no way better than the hydrogen ion[58, 4]. It has even been reported that the hydrogen system is more favourable to granulation than the calcium system[59] and that lime has a dispersing action on soil aggregates[60]. Recent researches would appear to point out that the effect of calcium upon aggregate formation is only indirect through its promoting micro-biological activity and consequent increased production of humus[61-63, 21].

The cementing materials in some soils may be iron hydroxide[64] but nothing is known with precision. This is especially true in lateritic soils that are known both for their high degree of aggregation and for their large iron content[65]. It is also possible that colloidal alumina may play a rôle similar to that of iron in aiding aggregation and in affecting, generally, the physical behaviour of soils.

Effects of Manures and Fertilizers.—The beneficial effects of manures upon granulation and aeration have been dealt with before; little is known concerning the effects of fertilizers. Continuous use of artificial fertilizers over a period of years has been known to result in a marked degradation in soil structure[66]. It has been experienced that superphosphate application in eroded fields aids in the improvement of structure; it is as yet difficult to conclude whether this effect is only due to the gypsum component of this fertilizer[67]. It is essential to recognize in this connection the complex relationships that are involved upon manure applications to the soil and the rather varied results obtained by different workers relative to the effects of manures on soil structure[33, 34, 68, 69]. Indirectly, however, all fertilizers will, as with manures and lime, have a large influence in the preservation of structure through increased foliage and root production.

Effects of Drainage, Waterlogging and Irrigation.—Proper drainage is followed by increased aeration, greater root development, more intense bacterial activity and the promotion of oxidation processes. The combined effects of these factors will normally lead to better granulation while their absence will be accompanied by deterioration in structure.

The breakdown of aggregation in the surface during irrigation leads to crust formation which produces unfavourable air and water relations for plant-growth[33]. Hence, the effect of irrigation water, especially in arid regions, on the structure of the surface soil is similar to that of natural rain in humid regions unless, of course, water-stable aggregates are present in the surface layers. In addition, irrigation waters containing unfavourable concentrations of soluble salts will have their deleterious effects on structure[70].

Importance of Structure for High Yields

From the foregoing, it is perhaps reasonable to expect that aggregate analysis may well become, in the near future, a soil characteristic of considerable importance. The agricultural significance of structure lies in its promoting (1) the capacity to absorb and retain moisture, (2) resistance to erosion, (3) free drainage and absence of waterlogging, and (4) easy workability. A combination of these factors will normally lead to greater productivity so long as plant food is adequate. On the contrary, common observations have often revealed that soils apparently rich in fertility elements have

not always been highly productive. At Indore, the positive effect of a manurial or a cultural treatment observed in one experiment on a particular field has very frequently been negatived in the same season on another[71]. It soon became apparent that the difference was mainly due to the existence, in reality, of two different types of fields, one well drained and the other, eroded and waterlogged. The average yields of seed cotton for the two types of fields over a period of years were approximately 414 lbs. and 194 lbs. per acre respectively. The results of manurial trials during different seasons have shown that, with few exceptions, both artificial nitrogenous fertilizers and organic manures produce a good response on the well-drained fields and a very much smaller or no response from poor fields[72]. This, at first sight, appeared contrary to the general expectation that poor soils should be more responsive to manuring than rich ones. When closely examined, however, these results showed that poor fields were often characterized not so much by a deficiency of essential nutrients as by a loss in structure resulting from impeded drainage and waterlogging.

Another interesting and characteristic difference exhibited between well-drained and badly drained or eroded fields has been in respect of the nature and extent of their surface cracking during summer fallow. It has been possible to make a quantitative measure of the amount of cracking in different fields. The results have shown that cracking is deeper and more extensive in a good field as compared to an infertile field[73].

These results only emphasize the importance of restoring structural conditions of the surface soil before crop yields can be enhanced by suitable manurial applications. Soil conservation depends essentially on the amount, kind and stability of the soil aggregates and the problem of improvement of eroded land for successful crop-growth resolves, therefore, into one of restoring structure[74]. Some preliminary results have shown that, for the black cotton soil, an economic way of achieving this will be by keeping the sub-surface soil in a poor field open by dressings of lightly fired soil; not only increased yields are obtained without manuring, but response to manures is also greater on soils so treated[75].

To sum up, plants require, in addition to nutrients, air and water for growth. In the absence of adequate amounts of moisture, plants cannot utilize soil nutrients and carry on their normal physiological functions. The growth of plant roots and the germination of seeds require favourable air conditions for respiration. Moreover, a small root system restricts the soil volume in which nutrients are available for the plant. Lack of sufficient air and water also affects bacterial activity and the very necessary aerobic biological processes are greatly hindered.

The air-water relations of the soil are dependent upon structure. While a good deal of work has hitherto been achieved on the relation of soil nutrients to crop-growth, only inadequate attention has been given to providing a favourable soil-air-water environment to the germinating seed and the growing crop. Recent developments in soil structure problems have made it possible to define more or less precisely what was only vaguely recognized hitherto as tilth. Future work should aim at fully utilizing this knowledge gained in regard to the significance of soil structure for maintaining or restoring soil fertility.

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SOME POST-WAR PROBLEMS OF JUTE

BY

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CONSUMPTION of jute has been considerably reduced owing to the war. Although jute is an important raw material for the war, its use for war purposes has not been sufficiently large to offset the fall in civilian consumption. This may be seen from the following table:—

World Consumption of Jute

(Lakhs of bales of 400 lbs.)

Season July—June	Consumption
1936-37	126
1937-38	113
1938-39	110
1939-40	113
1940-41	79
1941-42	88

In the third year of the war, the total consumption of jute fell by about a quarter of the pre-war consumption. The reduction in civilian consumption must have been much greater than this. Though no precise estimate of it is possible for want of relevant information, a few facts are noted in this connection.

Exports of raw jute and jute goods to the enemy and enemy-occupied countries, which in peace-time accounted for about 30 per cent. of the total world demand, have been completely stopped. In 1941-42, about 11 lakhs of bales of jute were consumed in India for war purposes. In the United States the civilian consumption of new jute bags has been reduced to half that of 1941, while the Government there is building up a large stock pile of raw jute and burlap from the available supply in the country. If the jute requirements for war purposes of the other Allied countries are also taken into consideration, it may not be wide off the mark to say that the total civilian consumption of jute (excluding secondhand products) is at present about half the pre-war consumption.

Thus the main problem of jute in the post-war period will be to increase its consumption to double the present rate of civilian consumption. The solution of this problem is dependent on a number of factors, some of which will be discussed below.

TRANSPORT

The reduction in the civilian consumption of jute has been brought about not by a fall in the actual demand for jute but because the demand cannot be made effective on account of transport difficulties. The civilian demand for jute in the Allied and neutral countries continues to be large and keen. But the demand can only be partially met because of insufficient shipping space available for exports of raw jute and jute goods from India. The cessation of hostilities will remove this difficulty, and the flow of raw jute and jute goods to countries overseas may be expected to resume its normal course. It may well be that with the progress of the war, easier conditions will prevail with regard to the shipping position, which may have a favourable effect on the jute trade. But many things may hamper the fulfilment of this expectation.

MARKETS

No other country in the world has got the natural advantages necessary for growing jute in large quantities. India, therefore, grows jute for the whole world. In times of peace about 85 per cent. of the total demand for jute, either as raw material or as manufactured goods, comes from abroad. The war has considerably restricted the market for jute. The following table shows the distribution of the demand for jute and the changes brought about by the war:—

World Demand for Indian Jute and Jute Goods

Countries	Average of 1936–37 to 1938–39 (April–March)		1941–42 (December–November)	
	Lakhs of bales	% of total	Lakhs of bales	% of total
Allied and Neutral (excluding India)	62·9	54·0	53·8	65·0
Enemy and Enemy-occupied	35·5	30·5	—	—
India	18·0	15·5	29·0	35·0
TOTAL ..	116·4	100·0	82·8	100·0

It appears from the above table—

(1) that the reduced consumption in the Allied and neutral countries has been more than offset by the increased consumption in India; and

(2) that the reduction in the consumption of jute equals on balance the loss of market in the enemy and enemy-occupied countries.

With the ending of the war, it may be expected

(1) that war-time restrictions will be removed and a major part of the markets, which is now cut off, whether in the enemy and enemy-occupied countries or in the Allied and neutral countries, will again be available for exports from India; and

(2) that the Indian consumption will be reduced to the peace-time level.

But things may not turn out to be as smooth as this. Jute substitutes, which are being grown in different parts of the world under the stress of the war, may hamper the complete restoration of the jute trade to its pre-war level. The opening up of new markets and the extension and development of the existing markets may become a matter of great importance for the post-war rehabilitation of the jute trade. The first step in this respect is to explore the potentialities of the Indian market for absorbing jute goods. It is with this end in view that the Indian Central Jute Committee has recently started an investigation of the Indian market for jute goods.

SUBSTITUTES

The next important step in this direction is a study of the economics and technology of the substitutes particularly with two objectives, *viz.*,

(1) to assess the danger to the jute trade from each of these substitutes; and

(2) to suggest improvement in the technology of jute goods with a view to improve their quality and reduce their price.

The Indian Central Jute Committee has undertaken an investigation on this point, but has to face great difficulties in getting facts in these days.

There is no doubt that substitutes have assumed great importance during the war. But forecasts about their future are premature. It is, however, important to note some tendencies in this respect.

If the war lasts long enough, the rationing of jute in the most important jute-consuming countries may decrease its subsequent peace-time importance, because of the introduction of substitutes to which the consumer may become accustomed by use over a sufficiently long period of time. This additional stimulus may even result in the development of a superior product made

of substitutes. Moreover, the abnormal war demand for substitutes may also increase the productive capacity of the substitute industries to such an extent that at the end of the war these industries will be forced to seek new markets in order to avoid a severe slump or may be kept up by tariffs and other similar devices. It is also worth noting that the Governments of some of the countries concerned are already planning to ensure the use of substitutes in place of jute even after the war. On the other hand, it may be recalled that in the last War also there was a search for jute substitutes in a number of countries. Several substitutes were found, but their cost of production was too high to compete with Indian jute. Consequently, these attempts, with the exception of a few, were given up after the War.

Another significant development in this war has been the attempt to grow jute on new territories. Experiments have now been initiated in Brazil, Argentine and the Soviet Union to grow jute on a commercial scale. It remains to be seen whether jute can be grown in any appreciable quantities in these countries and how far jute grown in these countries can compete in quality and price with Indian jute.

New Uses of Jute

The third important step in this direction is to explore new avenues for the use of jute. Experiments made abroad before the outbreak of war have already shown the possibility of using jute along new lines. The war itself has necessitated the manufacture of specialties such as the jute-cotton union fabric, jute tents, etc. Some of the Indian jute mills are now engaged in the manufacture of specialty fabrics, such as furniture material, scrim cloth, carpets, tarpaulin, etc. Readers of the Indian Central Jute Committee's *Monthly Bulletin* must have read about the promising and in some cases partially successful experiments in the Committee's Technological Research Laboratories to use jute in place of hemp and flax or for making garments or as a base for making file boards, or containers, etc. It is important to note that the war, while intensifying the search for substitutes of jute in many foreign countries, has at the same time created opportunities for trying jute in hitherto untried lines. The fullest advantage should be taken of such opportunities for directing the use of jute to the manufacture of new products or as substitutes for other fibres whose supplies in India have dwindled owing to the war. This subject forms an important part of the research programme of the Indian Central Jute Committee.

Agriculture

Last, but not the least, is the question of Agricultural improvements. It is obvious that improvement in the quality and yield of the fibre will enhance the competing power of jute. This aspect of the question, though sufficiently important in itself, has acquired enhanced importance on account of the developing menace of substitutes. The agricultural research programme of the Indian Central Jute Committee keeps this in full view.

Supply of Jute

One of the most difficult problems of jute has been the supply of raw jute. Even before the war, the jute market was seriously upset many a time owing to a bumper crop or an excessive supply against a reduced demand. Such maladjustments not only dislocate the jute market but also seriously affect the economic stability of the jute grower. The problem of supply still awaits a satisfactory solution. The war, however, has given some valuable experience. The bumper crop of 1940 was followed by compulsory restriction of the crop in 1941 and 1942. In the face of dwindling demand for jute the scheme of crop control initiated by the Government of Bengal has given fairly satisfactory results. Prices of raw jute have been well maintained and supplies have been fairly adjusted to demand. The manner in which this new weapon of crop control will be used in the post-war period is a question of first-rate importance to the future of jute. In order to throw some light on the problem of crop control, the Indian Central Jute Committee has undertaken an investigation into the elasticity of demand for jute.

Conclusion

The two most important problems likely to confront jute in the post-war period are: competition from substitutes on the demand side and control of the jute crop with a view to adjust supply to demand. It is clear that if jute goods are to recapture the lost ground after the war, immediate attention is necessary to the possibilities of making them cheaper and better and also more varied so that wider markets may be opened up.

LETTERS TO THE EDITOR

STATISTICAL FORMULÆ

It is perhaps worth while for statistical computers to have some fresh formulæ in addition to the familiar ones found in the common text-books. These formulæ can at least serve to open up new methods of checking results obtained by older methods. Here is a variance formula for k varieties, $x_1, x_2, \cdots\cdots x_k$:

$$k^2\sigma^2=(k-1)\sum_{r=1}^{r=k}(x_r-m)^2 - \sum_{r=1}^{r=k}\sum_{s=1}^{r=k}(x_r-m)(x_s-m),\ (r\neq s) \tag{1}$$

m being any number whatsoever.

It leads to the coefficient of intra-class correlation (R) for n families with varying number of members in each family, in a new form not noticed before:

$$R=1-\frac{\Sigma k_i^2\sigma_i^2}{\sigma^2\Sigma k_i(k_i-1)}, \tag{2}$$

where k_i, σ_i^2 denote the number of members and the variance respectively in the i-th family and σ^2 is the general variance. The proof of this formula is immediate, if we set

$$P_i=\sum_{s=1}^{r=k_i}(x_{ir}-m)(x_{is}-m),\ (r\neq s);$$

and $$S_i=(k_i-1)\sum_{x=1}^{r=k_i}(x_{ir}-m)^2,$$

where m is the general mean.

Then

$$R=\frac{\Sigma P_i}{\Sigma S_i}=1-\frac{\Sigma(S_i-P_i)}{\Sigma S_i}=1-\frac{\Sigma k_i^2\sigma_i^2}{\sigma^2\Sigma k_i(k_i-1)}.$$

It is readily seen that

$$R\geqslant-\Sigma k_i\sigma_i^2/\Sigma k_i(k_i-1)\sigma_i^2 \tag{3}$$

Lastly, if we consider three groups of variates (x), (y), (z) arranged as in the following table:

$$\begin{array}{cccccccc}
 & x_1 & x_2 & \cdot & \cdot & \cdot & x_m & \\
y_1 & z_{11} & z_{21} & \cdot & \cdot & \cdot & z_{m1} & v_1\\
y_2 & z_{12} & z_{22} & \cdot & \cdot & \cdot & z_{m2} & v_2\\
\cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot\\
\cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot\\
y_n & z_{1n} & z_{2n} & \cdot & \cdot & \cdot & z_{mn} & v_n\\
 & u_1 & u_2 & \cdot & \cdot & \cdot & u_m &
\end{array}$$

where $mv_i=z_{1i}+z_{2i}+\cdots+z_{mi}$, and $nu_j=z_{j1}+z_{j2}+\cdots+z_{jn}$, we can write down the mean (M) and the variance (σ^2), of mn variates of the form $ax_j+by_i+cz_{ji}$ ($j=1, 2,\cdots m$; $i=1, 2,\cdots n$), a, b, c being any arbitrary constants, thus:

$$M=a\bar{x}+b\bar{y}+c\bar{z}; \tag{4}$$

$$\sigma^2=a^2\sigma_x^2+b^2\sigma_y^2+c^2\sigma_z^2+2r_{xu}\,ac\,\sigma_u\sigma_x + 2r_{yv}\,bc\,\sigma_v\sigma_y; \tag{5}$$

in the usual notation of Statistics.

The proof follows by ordinary methods of expansion and summation. The last formula is useful in some genetic investigations.

Maharaja's College,
Mysore, A. A. Krishnaswami Ayyangar.
February 12, 1943.

SUPPRESSION OF RADIO INTERFERENCE FROM ELECTRIC MOTORS

THERE is experimental evidence to show that a d.c. operated motor, as a source of electrical interference, can be regarded as giving a *quasi*-continuous r-f spectrum. The electrical interference is due to these sparks between the brushes and the commutator. The frequency of the damped oscillations set up would depend not only on the inductance of the armature coil in one sector and its resistance and self-capacity, but also on the resistance of the air-gap across which the sparks take place. This resistance may vary between wide limits, especially under irregular spark conditions. The frequency component having the maximum intensity would lie in the region of the resonance frequency of the armature-sector.[1]

If it be accepted that the frequency components of the various high frequency waves originating, one after another, from the several sparks across the brush and the commutator, constitute a continuous spectrum, having the maximum energy in the region of the resonance frequency of the armature-sector, and that the observed peak values in the r-f noise field correspond to this frequency, it would be possible to displace the peak position towards a lower frequency region, thus minimising the noise field to a considerable extent. An attempt was made at minimising the noise field by this peak displacement method. The suggestion of such a displacement was originally in the work of Howe[2] on radio interference from traction systems.

Since noise-free reception is most desirable in the range, 7 Mc/s-20 Mc/s, which is most frequently employed for broadcast reception purposes, the work on noise suppression was carried out for this range. An Osler ceiling fan was chosen for the purpose. The armature of this fan had 36 commutator segments.

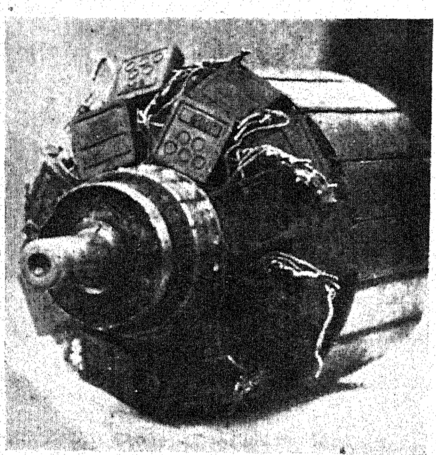


FIG. 1

Eighteen fixed condensers, each of value ·005 μf were inserted, each across a pair of commutator segments, successively and these were carefully fixed, so that the armature as a whole could smoothly rotate inside the field coil. A picture of the armature with fixed condensers is shown in Fig. 1.

The experiments with the Osler fan, with and without the fixed condensers inserted across consecutive pairs of commutator segments, showed considerable reduction in the noise field in the desired frequency range. In the lower frequency range, 3 Mc/s-6 Mc/s, the noise reduction was comparatively small, while in the still lower range, ·65 Mc/s-1·5 Mc/s, there was an increase in the noise field. The reduction in the noise field in the frequency range 7 Mc/s-20 Mc/s is shown in Fig. 2. The reduction in the acoustic output was also of

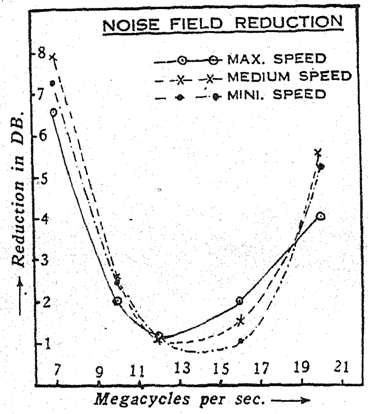


FIG. 2

the same order in the same range. This device of noise reduction can thus be regarded as satisfactory in this high frequency range.

The usual method of eliminating noise is to place a fixed condenser across the brushes of the motor. The results of such an experiment with a D.C. motor are given in Table I. The capacity-values of the condenser placed across the brushes of the motor, giving minimum noise for the different frequencies, are tabulated there.

TABLE I

D.C. Motor

Frequency (Mc/s)	Wavelength (Metres)	Capacity (μf)	Frequency (Mc/s)	Wavelength (Metres)	Capacity (μf)
·65	461·5	·5	4·0	75·0	·0005
·75	400·0	·5	5·0	60·0	·0005
·857	350·0	·5	6·0	50·0	·0005
1·05	285·7	·5	7·0	42·85	·0005
1·5	200·0	·5	10·0	30·00	·0005
3·0	100·0	·01	12·0	25·00	·0001
3·5	85·7	·01	16·0	18·75	·0001
			20·0	15·0	·0001

It can thus be said in a general way that the smaller capacities would be required for the higher frequencies and *vice versa*. The different motors having armatures of different inductance and self-capacity would, of course, require different values of capacity for minimum noise, even for the same frequency.

Physics Department,
Dacca University,
April 17, 1943.

S. R. KHASTGIR.
S. M. SEN.

1. Majumdar, S. C., Sen, S. M., and Khastgir, S. R., Communicated to *Ind. Jour. Physics*. 2. Howe, *Proc. I.R.E.*, 1937, **25**, p. 708.

X-RAY DIFFRACTION STUDY OF CYBOTAXIS AT THE INTERFACE

THE structure of liquid in the interior may be taken as vaguely ordered statistical swarms of molecules, or it may be looked upon as a three-dimensional *quasi*-crystalline structure of ordered molecules, with molecules obeying gaseous laws in the interspaces, so that the composite arrangement shows both ordered and disordered properties simultaneously. The interface between two liquids, or between a liquid and a gas is, however, a region of permanently oriented molecules. The purpose of this note to study the nature of the interface structure, by X-ray diffraction method. For this purpose CuK_α radiation, filtered through nickel was allowed to strike the liquid-air interface. The beam was extremely narrow and about 2 mm. in diameter. It passed grazing the interface, with its lower edge just inside the liquid, so that the pattern of the liquid in bulk, may not come out with great prominence. The photographed diffraction pattern was microphotometered and the *intensity → interplanar spacing curve* was drawn. Fourier analysis of the main peak was done according to the method of P. Debye and H. Menke.[1] This gave the atomic distribution curve of the atoms, about any atom in the liquid, and for methyl alcohol, the atomic distribution curve showed maxima at 1·57, 2·94, 4·23, 5·64 Å, at 20° C. and at 1·63, 2·98, 4·36, 5·75 Å at 40° C. The peak at 1·57 Å is interpreted as arising from $(CH_3\,OH)_3$; that at 2·94Å, as arising from $(CH_3\,OH)_2$, that peak at 4·36 Å has its origin in $(CH_3\,OH)$ and the last peak is due to oriented molecules at the interface. Values of integrated intensities under the peaks are proportional to the relative number of molecules of the different species. With a fixed arrangement the integrated area under the last peak does not vary with temperature; while the relative integrated areas under the first three peaks change considerably with temperature. Assuming the number of triple molecules as small, the ratio of the polymers with 1 and 2 molecules, as obtained from the above analysis of the diffraction pattern, comes out as 0·25 and 0·20, at 20° and 40° C. respectively. The same values calculated from association factor 'a' are 0·220 and 0·163 at the two temperatures mentioned ($a = 1{\cdot}82$ at 20° C. and 1·86 at 40° C.).

Dept. of Physics,
Science College,
Patna,
March 30, 1943.

BHOLANATH GHOSH.

1. P. Debye and H Menke, *Phys. Zeits.*, 1930, **31**, 797.

PREPARATION OF SUB-IODIDES OF CADMIUM AND ZINC

WOEHLER AND RODEWALD[1] prepared calcium sub-iodide in 1904. Preservation of sub-iodides is difficult. Samuel and Zakiuddin[2] succeeded in preserving calcium sub-iodide under carbon disulphide for some time. Kupfer[3] found that the compound could be preserved for a fairly long interval in parafinol and he studied X-ray diffraction of the sub-iodide.

Employing the method suggested by Samuel and Zakiuddin, the sub-iodides of cadmium and zinc have been successfully prepared by the author of the note. Iodine and cadmium of C.P. quality were taken in the ratio of their equivalent weights and placed in a steel bomb provided with an air-tight screw. The bomb was heated in an electric furnace to about 1000° C. for 10 hours and cooled suddenly by immersion in water. The resulting greenish yellow powder was found, on chemical analysis, to be cadmium sub-iodide. It could be preserved for over a week under carbon disulphide. Zinc sub-iodide, prepared in a similar way and easily preserved under carbon disulphide, was black in colour.

Absorption spectra of these sub-halides will be studied later.

Meteorological Office,
Poona 5,
February 13, 1943.

KHALILULLAH SIDDIQI.

1. Woehler and Rodewald, *Z. f. anorg. Chemie*, 1904, **61**, 54. 2. Samuel, R., and Zakiuddin, *Proc. Ind. Acad. Sci.*, 1935, **1**, 723. 3. Dr. Kupfer, Private Communication to Dr. Zakiuddin, 1936.

A NEW PHOTOMETRIC METHOD FOR THE ESTIMATION OF TOCOPHEROL (VITAMIN E)

PAUL MEUNIER AND ANDREE VINET[1] pointed out that a solution of α-tocopherol in alcohol (a few γ) when mixed with a reagent composed of one drop of a 1 per cent. solution of potassium ferricyanide and one drop of 1·5 per cent. solution of ferric chloride mixed with 1 c.c. chloroform and made up to 10 c.c. with absolute alcohol, developed a blue colour. Experiments were conducted to find out the suitability of this colour production as a photometric method for the estimation of tocopherol in oils.

A standard solution of α-tocopherol in absolute alcohol was prepared by methyl-alcoholic alkali saponification of α-tocopherol acetate according to the method of Emmerie.[2] The solution was standardised by the $FeCl_3$-$\alpha\alpha'$-di-

pyridyl method of Emmerie and Engel[3] using absolute alcoholic solutions of the reagents and the Pulfrich photometer with S. 50 filter and 1 cm. cell. During these estimations it was found that more consistent and reproducible results could be obtained by using a mixture of the solutions of ferric-chloride and αα'-dipyridyl for colour development rather than by using them one after another. The mixed reagent can be prepared by dissolving 16 mg. ferric-chloride and 20 mg. αα'-dipyridyl in 16 c.c. pure absolute alcohol, and using 2 c.c. of this every time for the blank and the experimental. According to this procedure α-tocopherol upto 100 γ can be estimated.

THE FERRIC CHLORIDE-POTASSIUM FERRICYANIDE REACTION

A standard graph (Fig. 1) showing the relationship between the content of α-tocopherol and the extinction coefficient was drawn. The intensity of the colour is proportional to the extinction coefficient and obeys Beer's law and the colour is stable over long periods. In all these estimations the colour was developed in 10 c.c. flasks. Filter S.72 and 1 cm. cells were used. The minimum quantity of the reagents were found out to be 0·4-0·5 c.c. of each of 0·4 per cent. ferric-chloride and 0·25 per cent. potassium ferricyanide solution up to 100 γ of α-tocopherol.

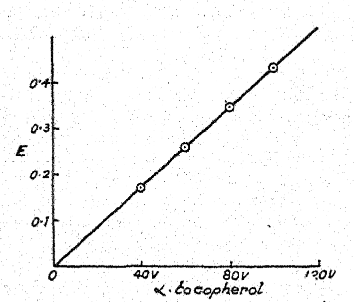


FIG. 1
$FeCl_3$, K_3 $FeCN_6$
10 cm., 1 cm. cell
(S. 72)

The reagent should be prepared fresh before each estimation by mixing together 0·5 c.c. of 0·4 per cent. $FeCl_3$ solution and 0·5 c.c. of 0·25 per cent. potassium ferricyanide solution adding 1 c.c. pure chloroform and making up to 11 c.c. with purified absolute alcohol (free from reducing substances). 5 c.c. of this reagent is used for blank and experimental. The reagent deteriorates rapidly and assumes a dark colour especially in the presence of light.

For the standardisation, known amounts of α-tocopherol in alcoholic solution were taken and the extinction coefficient was measured after developing the blue colour. Measurements can be made immediately after the reaction. A blank should be prepared every time.

Experiments were conducted with wheat germ oil saponified by methyl alcoholic KOH. The values (Table I) for the tocopherol content as estimated by the $FeCl_3$-$K_3Fe(cy)_6$ method agree well with those determined by αα'-dipyridyl method.

TABLE I

Vol. of solution in absolute alcohol	αα'-dipyridyl method		K_3F_3 (cy)$_6$ method	
	Ext. coefficient	γ α-tocopherol	Ext. coefficient	γ α-tocopherol
0·2 c.c.	0·097	28	0·125	29
0·4 c.c.	0·210	57·5	0·250	58
0·6 c.c.	0·315	85	0·370	85

It is clear from the above table that the extinction coefficient for the same concentration of α-tocopherol is greater by the K_3Fe (cy)$_6$ method than by the αα'-dipyridyl. A wheat germ oil solution in purified petroleum ether, when treated by the method of Parker and McFarlane[4] also gave similar results though as pointed out by McFarlane, the values were slightly higher than those obtained when the oil was saponified with alkali.

A pharmaceutical preparation (Ephynal, Roche) containing α-tocopherol acetate also gave concordant results by both methods [αα'-di-pyridyl and $K_3Fe(cy)_6$].

The tocopherol content of some vegetable oils by this method [$K_3Fe(cy)_6$] is being investigated.

Dept. of Biochemistry,
Indian Institute of Science,
Bangalore, K. RAMACHANDRAN.
May 1, 1943. Y. V. S. RAU.

1. Paul Meunier and Andree Vinet, *Comptes rendus*, 1940, **211**, 611–13. 2. Emmerie, *Rec. trav. him. pays. Bays.*, 1940, **59**, 246–48. 3. Emmerie and Engel, *Ibid.*, 1938, **57**, 1351–58. 4. Parker and McFarlane, *Can. J. Res.*, 1940, **18**, **B.** 405.

SYNTHESIS OF NEW ANTIMALARIALS RELATED TO ATEBRIN, PART I

IN atebrin, the side chain (I), *viz.*, δ-diethylamino-α-methyl-butylamine is attached to the carbon atom in position 5 of the acridine nucleus. It is interesting to note[1] that the nature of the aliphatic side-chain in position 5 of the 2-chloro-7-methoxy acridine plays a very important role in determining the chemotherapeutic index of various compounds of this series. The change from $.NH.(CH_2)_4.NEt_2$ to $.NH.CH\ (Me.(CH_2)_3.NEt_2$ reduces the index from 20 to 6·6, whilst that from $.NH.(CH_2)_3.NEt_2$ to $.NH.CH.(Me).(CH_2)_3.NEt_2$ raises the value from 6 to 15. It was, therefore, considered desirable to study the effect of different alkyl groups when introduced in position β, γ and δ of the side chain (I), on the antimalarial activity of the resulting compounds.

With this object in view, in this part, acridine derivatives (VIII), (IX) and (X) containing alkyl groups (R = Me, Et and isopropyl) in the β-position of the side chain, have been prepared as follows:

$$\overset{\alpha}{H_2N\cdot CH(Me)}\cdot\overset{\beta}{CH_2}\cdot\overset{\gamma}{CH_2}\cdot\overset{\delta}{CH_2}\cdot NEt_2 \quad (I)$$

$$CH_3\cdot CO\cdot CNa(R)\cdot CO_2Et \xrightarrow{Cl\cdot CH_2\cdot CH_2\cdot NEt_2} CH_3CO\cdot C(R)(CO_2Et)\cdot CH_2\cdot CH_2\cdot NEt_2$$

$$\downarrow \text{Hydrol. and decarboxyln.}$$

$$CH_3CO\cdot CHR\cdot CH_2\cdot CH_2\cdot NEt_2$$
$$(II: R{=}Me;\ III: R{=}Et;\ IV: R{=}\text{iso-Pr})$$

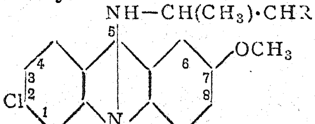
$$\downarrow NH_2OH$$

$$CH_3\cdot CH(NH_2)-CH(R)\cdot CH_2-CH_2-NEt_2 \xleftarrow{\text{Reducn.}} CH_3\cdot C(:NOH)\cdot CHR\cdot CH_2\cdot CH_2\cdot NEt_2$$

(V: R = Me; VI: R = Et; VII: R = iso-Pr). (II: b.p. 120°/25-30 mm., oxime, b.p. 85-90°/2-3 mm.; III: b.p. 100-105°/2-3 mm.; oxime b.p. 95-100°/2-3 mm.; IV: b.p. 115-20°/2-3 mm.)

The three diamines (V, b.p. 85-90°/2-3 mm.; VI, b.p. 95-100°/2-3 mm.; VII, b.p. 110-15°/2-3 mm.) have been condensed with 2: 5-dichloro-7-methoxy-acridine to give compounds (VIII, hydrochloride m.p. 258-60° decomp.), (IX, hydrochloride m.p. 265-67° decomp.), and (X, hydrochloride decomposing at 275°) respectively.

$NH-CH(CH_3)\cdot CHR\cdot CH_2\cdot CH_2\cdot NEt_2$



+2HCl

(VIII, R=Me; IX, R=Et; X, R=iso-Pr)

Organic Chemistry Section,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
March 29, 1943.

P. C. GUHA.
S. P. MUKHERJI.

[1] Henry, *J. Soc. Chem. Ind.*, 1936, p. 115.

SYNTHESIS OF NEW ANTIMALARIALS RELATED TO ATEBRIN, PART II

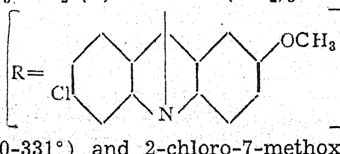
WITH a view to synthesising compounds like (V and VI) in which the imino-group in atebrin will be replaced by therapeutically useful carbamido and thiocarbamido groups, 2-chloro-7-methoxy-5-carbamido-acridine (III,

R—Cl (I)
↓
R—NH₂ (II)

R·NH·CO·NH₂ (III) ↓ R·NH·CO·NH·CHMe·(CH₂)₃·NEt₂ (V)

R—NH·CS·NH₂ (IV) ↓ R·NH·CS·NH·CHMe·(CH₂)₃·NEt₂ (VI)

[R=



]

m.p. 330-331°) and 2-chloro-7-methoxy-5-thiocarbamido-acridine (IV, m.p. 285-287°) have been prepared by the action of 2-chloro-5-amino-7-methoxy acridine (II), m.p. 265-267° (prepared according to the method of Adien, Albert and Bruce Ritchie[1] with urea and thiourea respectively. The urea and thiourea derivatives of the acridine compounds, *viz.*, compounds (V) and (VI) due to their insolubility could not, however, be made to react with δ-diethylamino-α-methyl-butylamine.

2 : 5-Dichloro-7-methoxyacridine reacting with semicarbazide and thiosemicarbazide has furnished the corresponding semicarbazide and thiosemicarbazide derivatives of the acridine, *viz.*, compounds (VII, m.p. 214-225°), and (VIII, m.p. 170-172°) respectively. Compounds (VII) and (VIII) in their turn, have been made to react with δ-diethylamino-α-methyl-butylamine to furnish compounds (IX), hydrochloride, m.p. 228-229° decomp., and (X) hydrochloride, m.p. 196-197° decomp. The pharmacological study of these semicarbazide and thiosemicarbazide derivatives of the chloro-methoxy-acridine, as also of the compounds (IX) and (X) which are analogous to the well-known anti-malarial drug atebrin, with the imino-group in position 5 replaced by semicarbazide and thiosemicarbazide groupings respectively, will, it is expected, furnish interesting results.

The acridine compound (XI) possessing a hydrazine residue in place of -NH-, and otherwise identical with atebrin was prepared by condensing 2: 5-dichloro-7-methoxy-acridine with $NH_2-N = CH(CH_3)-(CH_2)_3-NEt_2$ (XII), b.p. 90-95°/2-3 mm. All these acridine compounds are awaiting pharmacological examination.

R—Cl (I)

R·NH·NH·CO·NH₂ (VII) ↓ R·NH·NH·CO·NH·CH(CH₃)·(CH₂)₃NEt₂ (IX)

R·NH·NH·CS·NH₂ (VIII) ↓ R·NH·NH·CS·NH·CH(CH₃)·(CH₂)₃·NEt₂ (X)

R·NH·N:CHMe·(CH₂)₃·NEt₂ (XI)

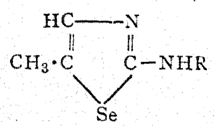
Organic Chemistry Section,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
March 29, 1943.

P. C. GUHA.
S. P. MUKHERJI.

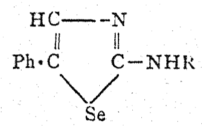
[1] Adieu, Albert and Bruce Ritchie, *J. Soc. Chem. Ind.*, 1941, p. 120.

SYNTHESIS OF SULPHANILAMIDO SELENAZOLES

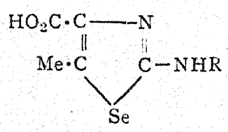
p-ACETAMINOBENZENE-SULPHOCHLORIDE has been made to react with (*i*) 2-amino-4-methylselenazole, (*ii*) 2-amino-4-phenyl-selenazole, (*iii*) 2-amino-4-methyl-5-carboxy-selenazole and seleno-hydantoin, to give 2-(*p*-acetamino-benzene-sulphonyl)-amino-4-methyl selenazole (I), m.p. 228-29°; 2-(*p*-acetamino-benzene-sulphonyl)-amino-4-phenyl selenazole- (II), m.p. 238-239°; 2-(*p*-acetamino-benzene-sulphonyl)-amino-4-methyl-selenozole-5-carboxylic acid (III), m.p. 238-39°; and 2-(*p*-acetyl-amino-benzene-sulphonyl)-amino-seleno-hydantion (IV), m.p. 263-64° (decomp.); respectively. The acetyl-compounds (I), (II) and (III) gave 2-(*p*-amino-benzene-sulphonyl)-amino-4-methyl-selenazole (V), m.p. 222-23°; 2-(*p*-amino-benzene-sulphonyl)-amino-4-phenyl-selenazole (VI), m.p. 231-32°; and 2-(*p*-amino-benzene-sulphanyl)-amino-4-methyl-selenazole-5-carboxylic acid (VII), m.p. 231-32°. Their toxicity and antibacterial properties are being studied.



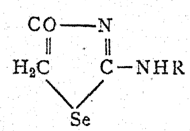
(I, V)



(II, VI)



(III, VII)



(IV)

[I-IV, R = $-SO_2\cdot C_6H_4-NHAc$
V-VII, R = $-SO_2\cdot C_6H_4\cdot NH_2$]

Organic Chemistry Section,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
March 12, 1943.

P. C. GUHA.
A. N. ROY.

SYNTHESIS OF SULPHANILAMIDE COMPOUNDS CONTAINING SEMI-CARBAZIDE-, THIOSEMICARBAZIDE- AND AMINO-GUANIDINE-RESIDUES

SULPHANILAMIDE compounds with urea, thiourea and guanidine have already been made. Alles[1] has made the interesting observation that aminoguanidine shows much less toxicity than guanidine. Sulphanilamide compounds of the *amino*-derivatives of urea, thiourea and guanidine or, in other words, of semicarbazides, thiosemicarbazides and aminoguanidines, have now been prepared.

The following compounds as also acetyl derivatives of III-VIII have been made:—

NH_2-C(NH)-NH-NH-SO_2-C_6H_4-NH_2COCH_3 (I)
NH_2-C(NH)-NH-NH-SO_2-C_6H_4-NO_2 (II)
NH_2-CO-NH-NH-SO_2-C_6H_4-NH_2 (III)
PhNH-CO-NH-NH-SO_2-C_6H_4-NH_2 (IV)
p-$CH_3C_6H_4$-NH-CO-NH-NH-SO_2-C_6H_4-NH_2 (V)
NH_2-CS-NH-NH-SO_2-C_6H_4-NH_2 (VI)
PhNHCS-NH-NH-SO_2-C_6H_4-NH_2 (VII)
p-CH_3-C_6H_4-NH-CS-NH-NH-SO_2-C_6H_4-NH_2 (VIII)

The pharmacological studies of these compounds are in progress.

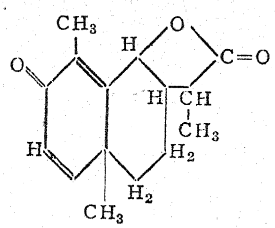
Organic Chemistry Section,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
March 12, 1943.

P. C. GUHA.
K. L. HANDA.

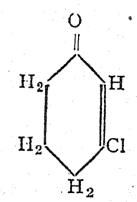
1. *J. Pharm. Soc.*, 1926, **28**, 251.

SYNTHESIS OF SANTONIN

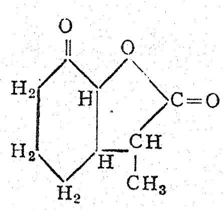
SANTONIN, the classical remedy for the treatment of ascaris or round-worms and oxyuris, is the chief constituent of the leaves of *Artemisia maritima* Linn. The chemical investigation of santonin has been carried out by Clemo, Haworth and Walton.* We have now achieved the synthesis of santonin by the series of reactions outlined below.



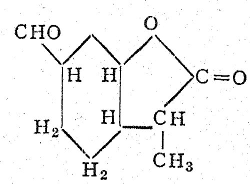
(I)



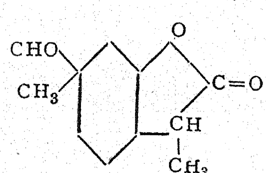
(II)



(III)



(IV)



(V)

3-Chloro-Δ^2-cyclohexen-1-one (II) on treatment with the Sodium Derivative of methyl malonic ester followed by hydrolysis with 30 per cent. sulphuric acid in dilute alcohol gave the keto lactone (III), which on condensation with ethyl formate gave (IV). Methylation of

(IV), effected by the treatment of its sodium compound with methyl iodide, gave (V). Condensation of (V) with methyl ethyl ketone took place, fortunately, in the desired direction and gave rise to santonin (I). The compound thus prepared had m.p. 171° C. and did not depress the m.p. of an authentic sample of santonin. It formed a semicarbozone identical with santonin semicarbozone. The synthetic product is, however, optically inactive. Details of the synthesis will be published shortly.

Maharaja Pratapsingh
Chemical Laboratory,
S. P. College,
Poona 2,
May 10, 1943.

(MISS) K. PARANJAPE.
N. L. PHALNIKER.
B. V. BHIDE.
K. S. NARGUND.

* Clems, Haworth and Walton, *J.C.S.*, 1929, 2368; 1930, 2579.

ISO-AMYL ALCOHOL AS A SOLVENT FOR THIOCHROME IN THE CHEMICAL ASSAY OF VITAMIN B_1

IN the thiochrome method for the estimation of vitamin B_1 (thiamine), iso-butyl alcohol is employed to extract the thiochrome formed from thiamine by oxidation with alkaline ferricyanide. Some difficulties in obtaining supplies of iso-butyl alcohol emphasised the need for a substitute. But no references are available in the literature about any other solvent being used in the place of iso-butyl alcohol for extraction of thiochrome. Preliminary trials with some common laboratory solvents showed that iso-amyl alcohol could be useful. Supplies of iso-amyl alcohol are easier to obtain and its use is more economical because it is cheaper and the recovery of used solvent is higher due to its much lower solubility in water. These points indicated the promising use of iso-amyl alcohol, and further experiments were carried out to establish its utility. For purposes of comparison, iso-amyl and iso-butyl alcohol were used in the estimation of vitamin B_1 on two aliquots of the same extract of each biological material obtained by employing a modified method of Swaminathan (1942). The relevant results obtained with various types of biological material are given in Table I.

TABLE I

Name of the Biological material	Iso-butyl alcohol: Vitamin B_1 $\mu g./g.$	Iso-butyl alcohol: Recovery of added vitamin per cent.	Iso-amyl alcohol: Vitamin B_1 $\mu g./g.$	Iso-amyl alcohol: Recovery of added vitamin per cent.
Cereals:				
1. Wheat, whole	4·4	94	4·3	96
2. Rice, raw milled	1·4	91	1·5	95
Pulses:				
3. Bengal gram	5·0	95	4·8	95
4. Red gram	1·2	88	1·1	87
5. Soya bean	1·3	95	1·3	93
Nuts:				
6. Groundnut	9·2	93	9·3	96
Vegetables:				
7. Carrot	0·53	94	0·58	96
8. Cabbage	0·67	88	0·69	90
Animal tissue:				
9. Liver, sheep	3·1	88	3·4	89
Yeasts:				
10. Yeast, brewer's, dried	50·0	100	48·1	96
11. Yeast extract	17·1	95	18·0	93

These results show that the amount of vitamin B_1 and the recovery of added vitamin are comparable with both the alcohols. The intensity of fluorescence was similar in all cases. It was found that the values for blanks with iso-amyl alcohol were in general lower than those obtained with iso-butyl alcohol, indicating that iso-amyl alcohol extracts interfering fluorescent materials to a lesser extent than iso-butyl alcohol. A study of the effect of the duration of shaking showed that all the extractable thiochrome was removed in one minute and there was no destruction even upto three minutes' shaking. Thus, thiochrome in iso-amyl alcohol is more stable than in iso-butyl alcohol since Conner and Straub (1941) have shown that the duration of shaking with iso-butyl alcohol should not exceed two minutes as there was some lowering in the intensity of fluorescence on shaking for three minutes. Hence iso-butyl alcohol can be substituted with advantage by iso-amyl alcohol in the extraction of thiochrome from reaction mixtures for the chemical estimation of vitamin B_1.

Nutrition Research Laboratories,
Indian Research Fund Association,
Coonoor,
April 17, 1943. K. K. P. NARASINGA RAO.

1. Conner, R. T., and Straub, G. J., *Ind. Eng. Chem., Anal. Ed.*, 1941, **13**, p. 380. 2. Swaminathan, M., *Ind. Jour. Med. Res.*, 1942, **30**, 263.

THE ADRENALINE AND ASCORBIC ACID CONTENTS OF THE SUPRARENAL GLANDS OF SLAUGHTERED ANIMALS

THE quantitative estimation of Adrenaline in the suprarenal glands of slaughtered animals is of considerable significance at the present time in view of the large-scale production of this hormone which is now being attempted by several firms in India. Neither the chemical nor the biological methods of estimation are entirely free from criticism. Among the chemical methods (colorimetric) the most popular has been that originally worked out by Folin which, however, is extremely unspecific for the compound: the more accurate seems to be the persulphate colour reaction, which was worked out into a quantitative method by Barker,[2] using the tintometer. In the present investigation both the Folin and Persulphate methods (the latter with modifications to suit estimations with the Dubosq colorimeter) were employed. Since ascorbic acid is intimately

associated with adrenaline in the adrenal glands and is in fact one of the most important interfering factors in the estimations of the latter with the Folin's reagent, a quantitative estimation of this vitamin was also undertaken by two methods, *viz.*, by titration with (*a*) dibromophenol-indophenol and (*b*) iodine solution, the latter of which, being unspecific, gave uniformly higher values. Tables I and II represent typical figures for the adrenaline and the vitamin C contents of cattle and sheep.

It will be seen that the values for adrenaline by the Folin's method are considerably higher than those by the Persulphate method. The yield of adrenaline from natural sources has been claimed to be quantitative[3]: the figures by the latter method agree better with the actual yields obtained in this laboratory. It will also be evident from a perusal of the tables that cattle glands contain more adrenaline (expressed in terms of mg. of adrenaline per gram of gland) than the sheep glands, but are relatively poorer in ascorbic acid.

For the preparation of cortical hormones, which are being investigated in this laboratory under the auspices of the Board of Scientific and Industrial Research, the ideal method appeared to be to start with the dissected cortex, and this led to a careful study of the relative distribution of adrenaline and vitamin C in the cortex and in the medulla separately. The results obtained should be of

TABLE I
Cattle Glands (Whole)

No.	*Adrenaline* Weight (mg.) per gram of gland		*Vitamin C* Weight (mg.) per gram of gland	
	Folin's	Persulphate	Indicator	Iodine
(1)	2·95	1·83	0·91	1·25
(2)	3·00	1·84	0·89	1·17
(3)	3·20	1·87	0·93	1·26
Average	3·05	1·85	0·91	1·23

TABLE II
Sheep Glands (Whole)

No.	*Adrenaline* Weight (mg.) per gram of gland		*Vitamin C* Weight (mg.) per gram of gland	
	Folin's	Persulphate	Indicator	Iodine
(1)	2·51	1·50	1·28	1·78
(2)	2·65	1·62	1·37	1·85
(3)	2·45	1·60	1·26	1·67
Average	2·54	1·57	1·30	1·73

TABLE III
Dissected Cattle Glands

Percentage of Medulla	*Adrenaline* (mg. per gram of tissue)				*Vitamin C* (mg. per gram of tissue)			
	Medulla		Cortex		Medulla		Cortex	
	Folin	Per-sulphate	Folin	Per-sulphate	Indicator	I_2	Indicator	I_2
(1) 28·9	6·91	4·62	1·37	0·39	0·96	1·40	1·09	1·42
(2) 28·2	6·64	4·74	1·25	0·36	0·91	1·37	0·96	1·35
(3) 29·4	6·17	5·06	1·19	0·35	0·93	1·22	1·14	1·37
Average 28·8	6·57	4·80	1·27	0·37	0·93	1·33	1·06	1·38

TABLE IV
Dissected Sheep Glands

Percentage of Medulla	*Adrenaline* (mg. per gram of tissue)				*Vitamin C* (mg. per gram of tissue)			
	Medulla		Cortex		Medulla		Cortex	
	Folin	Per-sulphate	Folin	Per-sulphate	Indicator	I_2	Indicator	I_2
(1) 19·1	6·37	5·53	1·12	0·30	0·90	1·39	1·34	1·74
(2) 18·9	6·41	5·57	1·19	0·35	1·01	1·43	1·53	1·92
(3) 19·1	6·74	5·46	1·19	0·28	1·07	1·55	1·49	1·89
Average 19·0	6·50	5·52	1·17	0·31	0·99	1·46	1·45	1·87

great interest. Tables III and IV represent typical values. They show clearly that the amount of adrenaline present in the medulla alone is about 82 per cent. of the total amount of this hormone present in the whole gland and actual experiments carried out in this laboratory on the recovery of adrenaline from the separated medulla have confirmed this observation. It will also be noted that the disparity between the values for adrenaline by the Folin and Persulphate methods is considerably larger in the cortex than in the medulla—a disparity which is too great to be explained merely by the difference between the vitamin C contents of the cortex and the medulla.

The expenses of this investigation have been met entirely from funds supplied by the Board of Scientific and Industrial Research to whom our grateful thanks are due.

Presidency College,
Madras,
April 26, 1943.

B. B. Dey.
P. S. Krishnan.
V. Sreenivasan.

1. Folin, Cannen and Denis, *J. Biol. Chem.*, 1913, **13**, 477. 2. Barker, Eastland and Evers, *Biochem. J.*, 1933, **26**, 2129. 3. Barger, "Organic Chemistry in Biology and Medicine", 1930.

REICHERT VALUE OF BUTTER-FAT

From time to time investigators in various parts of India publish Reichert values and other constants, determined on butter-fat, prepared from the milk of single animals. These figures often suggest that the Provincial standards for Reichert value are too high and they are much quoted by the defence in prosecutions for the sale of adulterated butter or ghee.

I think the explanation may be a very simple one. A chemist wishing to determine such figures will usually ask a local cattle owner to bring an animal to his laboratory for milking under supervision. Quite a small amount of milk will provide the amount of fat needed for analysis; but if the cattleman is told that this is all that is required he will, quite naturally, send an animal which gives only a small yield. It is an accepted fact that the Reichert value of butter-fat falls rapidly as the animal approaches the end of the period of lactation; so that butter-fat obtained in this way is not representative of the butter-fat from normal animals.

Published figures purporting to be the Reichert values of the milk of single animals should be accepted only with the greatest reserve in the absence of a precise statement of either the stage of lactation of the animals, or the daily yield of milk at the time of sampling.

Laboratories of the
Government Analyst,
Guindy,
May 3, 1943.

Herbert Hawley.

2-N[1]-SULPHANILAMIDO-5-ISOPROPYL-THIAZOLE IN MONKEY MALARIA

In a previous communication[1] effectiveness of (*i*) 2-N[1]-Sulphanilamido-5-ethylthizole and (*ii*) N[1]-methyl-sulphathiazole in monkey malaria was reported. In the course of study of several 2-N[1]-Sulphanilamido-5-alkyl-thiazoles in monkey malaria, 2-N[1]-Sulphanilamido-5-isopropylthiazole has been found to be effective in eradicating the malarial infection in monkeys. These compounds were prepared by Ganapathi *et al.*[2] in the Chemotherapy Department of the Haffkine Institute and supplied by that department.

Rhesus monkeys infected with K_2 strain of *Plasmodium knowlesi* were used for the purpose of the experiments. Parasites in the peripheral blood were enumerated daily and when the infection had reached a moderate degree (about ten parasites per 10,000 R.B.C.'s) the drug was administered orally, in the form of tragacanth suspension through a stomach tube. The dose administered was 1 gm. given once a day for three consecutive days. It was observed that after administration of the drug the parasites disappeared completely from the peripheral blood in four days. In a second set of experiments a dose of 1 gm. was administered orally only once, and here also the parasites disappeared from the peripheral blood in four days. In a third set of experiments a dose of 0·5 gm. was administered orally only once and in this case also the parasites disappeared from the peripheral blood in four days. It was further observed that there was no relapse in monkeys treated with this drug while the controls similarly treated with atebrin showed a relapse. The question of radical cure was, therefore, investigated in case of animals treated with this drug. The blood of animals treated with a dose of 1 gm. given only once was found to be non-infective to normal animals three weeks after the disappearance of the parasites from the peripheral blood, and the animals so treated were as susceptible to fresh infection as normal animals. The progress of the infection on reinfection was same as in the first infection, showing thereby that the monkeys did not acquire any immunity due to the previous infection.

It was, therefore, concluded that 2-N[1]-Sulphanilamido-5-isopropylthiazole causes a disappearance of parasites from peripheral blood and probably produces a radical cure in *Rhesus* monkeys infected with *P. knowlesi*. The dose required for the eradication of the parasites indicates the therapeutic usefulness of the drug in the treatment of human malaria. Investigations on this point along with the pharmacology of this drug are in progress and will be reported later.

Dept. of Pharmacology,
Haffkine Institute,
Bombay,
March 25, 1943.

B. V. Patel.

1. Patel, B. V., *Curr. Sci.*, 1942, **11**, 187. 2. Ganapathi, K., Shirsat, M. V., and Deliwala, C. V., *Proc. Ind. Acad. Sci.*, 1941, **14A**, 630.

CRYPTOSTEGIA GRANDIFLORA, R. Br. A RUBBER-BEARING PLANT FOUND IN INDIA

THE present shortage of rubber, a vital strategic material, has focussed attention on sources other than *Hevea braziliensis*. Interest in such investigations was shown so early as sixty years ago but the supremacy of Hevea precluded any commercial exploitation of even the most promising alternatives. One such plant is *Cryptostegia grandiflora*, R. Br.[1] Its analysis was published in 1907 by Dunstan[2] who reported over 80 per cent. of rubber in the coagulum together with 9 per cent. of resin. The quality of the rubber also was favourably reported upon.

Now, of course, any substitute for Hevea is welcome practically regardless of cost. The U.S.A., for example, is covering a portion of her requirements from a South American plant, Guayule (*Parthenium argentatum*) and Soviet Russia is encouraging the cultivation of dandelion (*Taraxacum-koksaghyz*) to minimise rubber imports. Similarly, in India, a list of plants whose study might lead to a promising source has been compiled by Dent[3] who, in his survey, includes, among others, *Cryptostegia grandiflora*.

Cryptostegia grandiflora is stated to be a native of Madagascar and has become naturalised in India, where it is found in the plains and up to about 2,000 feet. It is a large evergreen, woody climber, with copious milky juice, often cultivated in the gardens for its flowers. The leaves are opposite, 2-4 inches long, 1·5-2 inches broad, elliptic, rather thick, glossy and green; flowers about 2 inches across of a pinkish purple colour, showy, fruit 4-5 inches long by 1 inch broad near the base, woody, angled or winged. Flowers during hot and rainy seasons. Though susceptible to extremes of heat and cold it grows well in all climates with rainfall from half an inch to 83 inches but it appears to thrive best in places with rainfall averaging between 20-40 inches a year.

The latex of *Cryptostegia* obtained from different parts of the country has been examined and the results are tabulated below:—

	Rainfall in inches during 1942	% Coagulum in latex	% in Coagulum	
			Rubber	Resin
Multan	12·80	17·9	79·8	12·5
Delhi	37·73	12·6	88·0	12·0
Rajputana	24·89	27·0	81·9	11·5
Poona	31·28	26·56	86·0	8·3
Gwalior*	30·33	..	74·2	9·7
Jalaum*	31·45	.	84·5	9·0
Coimbatore	20·38	17·06	86·4	12·4
Bombay*	70·63	..	66·7	10·5
Dehra Dun	99·10	15·6	80·0	16·8
Hevea braziliensis (for comparison)		40·0	89·0	4·1

* Taken from Dunstan.[2]

The percentage of rubber in the coagulum thus averages about 80 per cent. and that of resins 10 per cent., apparently irrespective of the climate and soil where cryptostegia grows. Also, the latex from the plant in some localities is thinner, yielding less of coagulum than those from others. At first it would appear that the lattices obtained from regions with rainfall between 20 and 35 inches a year are richer in coagulum than those from either the drier or the moister climates. This may be so, but with our scanty data, it is unsafe to generalise especially as the age and season factors have to be allowed for. Probably, the latex from a younger plant is thinner than that of a mature plant. All these need further investigation.

Cryptostegia grandiflora as a war-time substitute for Hevea has the further advantage in

Close-up view of leaves

its reported ability to yield latex within a year of its sowing. Harvesting cryptostegia is thus within the span of an agricultural operation and this very great advantage of the time factor needs no emphasis. But, for large-scale successful tapping or the extraction of rubber from small woody plants of the size of cryptostegia new methods are needed. Such methods were till now not developed and this is the chief reason for the plant, cryptostegia not establishing itself as a source of rubber. The orthodox methods of tapping fail with shrubs which at one cutting yield no more than a few drops of the latex. In the absence of suitable technique for tapping, all the other advantages of cryptostegia, *viz.*, that, unlike Hevea, it is not fastidious about the climate and soil, that it can be raised from seeds or cuttings and that it can be tapped within a year, will be of no more than academic interest. Some efforts have already been made to evolve a suitable technique. For example, the extraction of the rubber by solvents is possible but the quality of the rubber so obtained, is stated to be poor. Similarly the autoclaving of the crushed and powdered plant has yielded low results. The method of employing disintegration and flotation process, developed for winning rubber from Guayule, has not yet been successfully employed in the case of cryptostegia.

Releasing the rubber from the woody shrubs might be possible after disintegration brought about through selective attack by insects,

fungus or enzymes on woody parts, and this line of attack is suggested as a promising line of investigation. The author has written this note, primarily to draw the attention of scientific workers to the possibilities of cryptostegia and the problem of its tapping. Apart from its scientific interest, any solution to this problem would be of very great service to the country just now.

Forest Research Institute,
Dehra Dun, K. L. BUDHIRAJA.
February 19, 1943.

1. Anon, 1882, "New India Rubber Plant," *Indian Forester*, **10**, 202. 2. Dunstan, W. R, "*Cryptostegia grandiflora* Rubber from India," *Bull. Imp. Inst.*, 1907, **5**, 371 Dunstan, W. R., "The Rubber of *Cryptostegia grandiflora*," *Bull. Imp. Inst.*, 1912, **10**, 210. 3. Dent, T. V., "Possible War-time Sources of Vegetable Rubber in India," *Ind. For. Leaflet* (*Silviculture*), 1942, No. 22.

AN EQUATION FOR THE PERCOLATION OF WATER IN SODIUM-CALCIUM SOILS

IT is well known that of the various kinds of soils sodium soil is the least pervious to water. When a calcium soil is treated with sodium carbonate the exchangeable calcium is replaced by sodium in the soil, and differing amounts of sodium carbonate added lead to the formation of different grades of sodium-calcium soils. The adsorbed sodium has been found to be responsible for the impermeability of alkali soils. An attempt has been made to study in closer detail the effect of varying amounts of exchangeable sodium on the permeability of calcium soils.

In his studies on the permeability of alkali soils A. E. Harris[1] pointed out that the permeability is logarithmically related to a value "S" which represents the degree of saturation of the soil complex with respect to sodium ion, which may be expressed by an equation of the form:

$$Y = ae^{-b}\,S, \qquad (1)$$

where Y = rate of percolation of water,

$$S = \frac{\text{exchangeable sodium}}{\text{base-exchange capacity}} \times 100$$

and a and b, constants.

The applicability of this formula has been tested in a number of soils. Pure mineral non-calcareous calcium soils were prepared by digesting the soil sample first with N-NaOH, and then with 0·05 N-HCl. After washing away the soluble matter it was leached with N-$CaCl_2$. The free salt was removed by repeated washing with distilled water until the filtrate gave no test for chloride. The residue was dried at 100° C.

10 Gm. samples of this calcium soil were treated with different quantities of Na_2CO_3 with a view to introduce different amounts of exchangeable sodium. These samples differing only in their S-value were tested for permeability in percolation tubes by observing the descent of the level of water per hour. The percolation rate was also calculated by the above formula. The value of S was obtained by determining the exchangeable calcium in each mixture. A typical result of these experiments is given in Table I.

TABLE I

Soil No. 10, Clay: 26·6 per cent.
Base exchange capacity: 16·6 m.e.
$a = 0·154$, $b = 0·032$

No.	Na_2CO_3 added	S	Y observed (cm./hour)	Y calculated
1	1%	20·5	(80×10^{-3})	(80×10^{-3})
2	2%	29·8	60 ,,	58·8 ,,
3	3%	43·4	40 ,,	38·0 ,,
4	4%	63·2	20 ,,	20·07 ,,
5	5%	78·7	12 ,,	12·18 ,,
6	6%	83·2	10 ,,	10·53 ,,
7	7%	91·7	(8 ,,)	(8·0 ,,)
8	10%	95·8	8 ,,	7·02 ,,

We have examined six natural soils which were treated as explained above and five artificially prepared mixtures of clay and sand and found that the equation:

$$Y = ae^{-b}\,S$$

holds good in every case.

The constants 'a' and 'b' are arbitrary and vary from soil to soil. An attempt has been made to correlate them with some characteristic properties of the soil. Table II shows the relation between the base exchange capacity of six soils and the constant 'b'.

TABLE II

Soil No.	Base exch. capacity (B)	b	b/B
12	14·8	·0283	$1·9 \times 10^{-3}$
5	20·5	·0400	2·0 ,,
10	16·6	·0320	1·9 ,,
3	13·4	·0250	1·8 ,,
13	9·88	·0180	1·8 ,,
15	7·11	·0130	1·8 ,,

It will be seen from the last column that the ratio b/B is very nearly a constant, and hence the arbitrary constant 'b' in Harris equation is directly related to the base-exchange capacity of the soil.

The constant 'a' in the above equation may probably be interpreted in terms of another known characteristic of the soil—the clay content. It is found that 'a' is inversely proportional to the logarithm of the clay content. The relevant data are given in Table III.

TABLE III

Soil No.	Clay content (c)	a	$a \log c$
12	27·44%	0·136	0·1967
5	27·6	0·136	0·1967
10	26·6	0·154	0·2290
3	52·43	0·083	0·1430
13	21·85	0·178	0·2380
15	26·32	0·138	0·1990

The small variations of values in the last column might be due to the presence of secondary particles. To clear this point experiments were carried out with artificial mixtures of pure sand and the colloidal part of the soil. The results obtained are summarised in Table IV.

TABLE IV

Soil No.	B	Clay % (c)	Sand %	b	a	b/B	$a \log c$
1	31·8	100	0	·057	·129	$1·8 \times 10^{-3}$	·2580
2	15·9	50	50	·028	·148	1·8 ,,	·2500
3	9·54	30	70	·018	·177	1·9 ,,	·2632
4	7·95	25	75	·016	·180	1·8 ,,	·2492
5	6·36	20	80	·012	·195	1·9 ,,	·2542

The significance of the values in the last two columns will be easily understood. To make certain we carried out further experiments with pure clay prepared from three different soils in which B was different, and also with artificial mixtures in which B was kept constant and the clay content varied. The results obtained confirm the conclusion already arrived at.

If we now substitute the new values for 'a' and 'b' in equation (1) we obtain the expression:

$$Y = \frac{k_1}{\log c} \cdot e^{-k_2 BS}$$

And since

$$S = \frac{(Na^+)}{B} \times 100, \text{ the final equation is}$$

$$Y = \frac{k_1}{\log c} \cdot e^{-k_2'(Na^+)}$$

where k_1 has the value round about 0·25, and k_2' is almost exactly equal to 0·18.

This apparently very satisfactory equation fails, however, in the two limiting cases, namely in pure calcium, and pure sodium, soils. The problem is further being studied.

Lucknow University, K. P. SHUKLA.
February 15, 1943. M. R. NAYAR.

[1] Harris, A. E., *Soil Sci.*, 1931, **32**, 435.

INFLUENCE OF Na^+, NH_4^+ AND K^+ IONS ON THE PERMEABILITY OF CALCIUM SOILS

AMONG the various factors which determine the porosity of soils to water, the specific effect of adsorbed ions is often one of the most important. It is well known that alkali soils, in which exchangeable sodium predominates among the exchangeable bases, are impervious to water, while normal soils, which are mostly calcium soils, are quite porous. Generally speaking, soils saturated with monovalent cations allow water to filter through less readily than those saturated with divalent ones.

Here an attempt has been made to compare the effect of three alkali cations on soil permeability when increasing amounts of them replace exchangeable calcium in a pure calcium saturated soil. Pure soils saturated with calcium, sodium, ammonium and potassium were prepared by leaching first with N/20 HCl and then by a litre of the normal solution of respective chlorides. Free salts were removed by washing first with water and finally with alcohol. Soil samples containing an exchangeable alkali cation and exchangeable calcium were prepared by mixing them in desired proportion. These samples were then subjected to comparative permeability tests. The second, fourth and sixth columns of the table below give the rates of percolation of water.

The rates of percolation were also calculated by means of an empirical relation first enunciated by A. E. Harris[1] in the case of an alkali soil. This equation is:

$$Y = ae^{-b}S$$

where Y is the rate of percolation; S is the percentage saturation with respect to the alkali ion, that is

$$S = \frac{\text{Amount of alkali cation}}{\text{Base-exchange capacity}} \times 100,$$

a and b are constants.

The calculated values in the three cases are given in the third, fifth and seventh columns of the table, while the equations which fit best with observed values are given in the last row.

S.	Rates of percolation in inch per hour					
	Na^+		NH_4^+		K^+	
	observed	calculated	observed	calculated	observed	calculated
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	·190	·138	·190	·172	·190	·180
10	·09	·090	·133	·133	·171	·169
20	·054	·054	·100	·103	·158	·158
30	·033	·033	·079	·080	·144	·148
40	·021	·024	·063	·062	·138	·138
50	·013	·014	·044	·048	·129	·129
60	·008	·009	·038	·037	·117	·121
70	·006	·006	·029	·029	·113	·113
80	·004	·004	·023	·022	·106	·103
90	·006	·002	·017	·017	·100	·099
100	·006	·002	·012	·013	·091	·093
Equations which fit best with observed values	$Y = 0·138e^{-·044s}$		$Y = 0·172e^{-·0227s}$		$Y = 0·180e^{-·0067s}$	

It will be noted that in general the exponential relation between Y and S is satisfied. When S = 0 the soil complex is wholly saturated with exchangeable calcium for which the observed value is 0·19 inch per hour; but the calculated values (values of the constant '*a*') are far less and they increase from sodium to potassium.

The constant '*a*' seems to increase with the atomic weight while the constant '*b*' decreases in the same order.

The effect of the three ions in decreasing the rate of percolation in calcium soil thus is as:

$$Na^+ > NH_4^+ > K^+$$

which is also the order of increasing ionic radius.

Lucknow University, M. R. NAYAR.
February 27, 1943. K. P. SHUKLA.

1. Harris, A. E., *Soil Sci.*, 1931, **32**, 435.

INCLINED EXTINCTION IN THE HYPERSTHENES OF CHARNOCKITES

DR. P. K. GHOSH has summarised the views put forward to explain oblique extinction observed in the hypersthenes of Charnockites, and inclines to the view of K. K. Sen Gupta that the oblique extinction is due to the persistence of original amphibolic cleavages in the hypersthenes.[1]

Mr. M. S. Sadasiviah, Lecturer in Geology, Central College, has made detailed statistical studies of oblique extinction observed in about a 100 mineral grains of the hypersthenes occurring in the Charnockites of Halagur. Three lines of statistical investigation have been instituted to study the oblique extinction; (1) the pleochroic scheme of the several mineral grains, (2) the optic figures and (3) the calculated angles with the aid of certain Crystallo-optic formulæ.

The pleochroic scheme of the hypersthene of Halagur is X = pink, Y = brownish-yellow and Z = bluish-green. The principal sections of the mineral grains have, therefore, the pleochroic scheme, XZ = pink to bluish-green, XY=pink to brownish-yellow and YZ=brownish-yellow to bluish-green. XZ sections give optic normal figures, YZ give BX_{ac} figures, and XY, BX_0 figures. XZ and YZ sections give straight extinction, but, when the pleochroic shades depart from this scheme, oblique extinction results, the angles varying from 0° to a maximum of 26°, the maximum angle being observed on a section giving an uncentred optic axis figure. Since the optic orientation of hypersthene is XZ//010, and X is perpendicular to 100, the sections giving optic axis figures (centred or uncentred) are either domes or pyramids. Since hypersthenes, like other Orthorhombic minerals with prismatic cleavages, give straight extinction in the 010-100 zone, symmetrical extinction in the 001-100 and 001-010 zones, and oblique extinction in all *other* zones,[2] theoretical extinction angles were calculated for the 001-100 and 001-010 zones with the aid of the Rosenbusch-Wulfing formula.[3]

$$\text{Tan } 2\gamma = \frac{\cos\phi\,[\tan(V+\Gamma) - \tan(\Gamma - V)]}{1 - \cos^2\phi\,\tan(V+\Gamma).\tan(\Gamma - V)}.$$

The theoretical angles were calculated for the acute prismatic angle both of pyroxenic and amphibolic cleavages.

Inclination of face to (001) = ϕ	$\gamma = 45°\ 52'$ Pyroxene Cl.	$\gamma = 28°$ Amphibole Cl.
0°	45° 52′	28°
10°	45° 45′	27° 47½′
20°	45° 45′	27° 47′
30°	43° 4½′	25° 58′
40°	41° 44½′	24° 10′
50°	36° 53½′	21° 36′
60°	31° 46′	18° 1½′
70°	24° 22′	13° 11½
80°	13° 45½′	7° 3′
90°	0°	0°

Since the maximum extinction angle observed in the hypersthene of Halagur is 26° and the average angles are 11°-13°, the maximum extinction observed should be on a dome face having an inclination of 70° to 001 (if the cleavage observed is pyroxenic) or a dome face inclined to 001 at 30° (if the cleavage were amphibolic). The indices of these hypothetical faces were calculated by Neumann's Gnomonic Method[4] and were found to be (011), (101), (041) and (401). But neither of these domes occur in amblystegite, the variety of hypersthene observed in Charnockites.

Therefore resort was made to the Ferro-Brandavo formula for calculating extinction angles on the pyramids (111) and (232), occurring in amblystegite (Fig. 1-Stereographic Projection with facial poles and their calculated extinction angles). The Ferro-Brandavo formula is,

$$\text{Cot } 2\gamma = \frac{(\cos\mu\cos\nu - \sin\mu\sin\nu\cos^2 v) + (\sin\mu\sin\nu)\sin^2\phi}{[\cos v\sin(\mu+\nu)]\cos\phi - [\sin\nu\sin(\mu-\nu)]\sin\phi}.$$

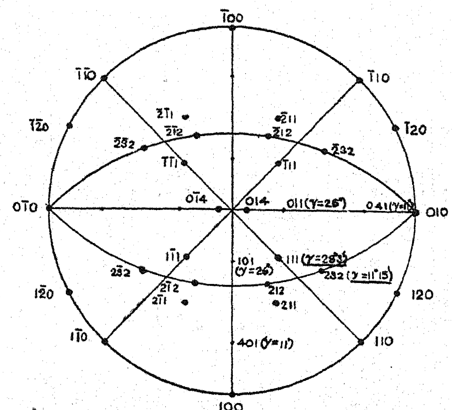


FIG. 1

Calculated Extinction Angles (γ) in Amblystegite

The value of 2 V (optic axial angle) required in this calculation was determined on the Federov's Stage by the method of direct measurement of the optic axial angle by sharp extinction at the emergence of the optic axes, in the 45° position.[5] The value of 2 V for the Halagur hypersthene is 54° 42'. The extinction angles calculated by the Ferro-Brandavo formula for (111) and (232) are 28° 3' and 11° 15', assuming the cleavages to be pyroxenic. Since the calculated values agree closely with the observed values in hypersthenes of Halagur (26° and 11°-13°), it is hereby inferred that the oblique extinction observed in the hypersthenes are on the *pyramidal* faces and that the cleavages are pyroxenic.

Dept. of Geology,
Central College,
University of Mysore,
Bangalore, P. R. J. NAIDU.
May 7, 1943.

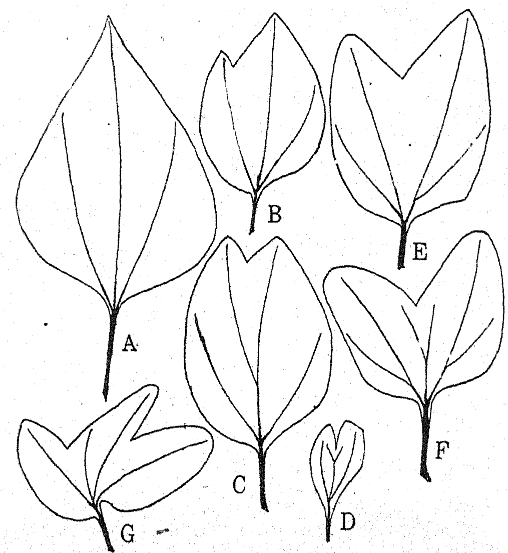
1. G. S. I., *Professional Paper, No.* 15, 1941, p. 10. 2. Winchell, A. N., *Text-Book of Optical Mineralogy*, 1931, p. 167. 3. Johannsen, A., *Manual of Petrographic Methods*, 1918, p. 402. 4. Barker, T. V., *Graphical and Tabular Methods in Crystallography*, 1922, p. 36. 5. Johannsen, A., *Op. cit.*, p. 493.

ANOMALOUS LEAVES OF *HELLANTHUS ANNUUS* LINN. N. O. COMPOSITÆ

THE abnormal bilobed opposite leaves (Figs. B-G) differ from the normal leaf (Fig. A) in shape, size and venation. Out of 323 seedlings only seven had such abnormal leaves, one on each seedling. There was one trilobed leaf; others were bilobed. It was observed that leaving aside the cotyledons third, fourth, fifth, sixth and seventh leaves showed abnormality of one of these types. Either one leaf or both the leaves at a node was found to be abnormal.

The arrangement of the leaves was at first opposite and decussate but later it became alternate. It has been observed that in a plant growing under normal conditions, the change of phyllotaxy begins after about four pairs of opposite leaves have appeared. Out of the seven seedlings described above, four were of that type. The fifth one had the change of phyllotaxy after the first pair of opposite leaves had appeared. In the case of the sixth one alternate leaf intervened between the first and the second pair of opposite leaves. The last one did not agree with those already described. It had two leaves at a node, one at right angles to the other. These intervened with the alternate leaf of the second and the fourth, and the fourth and the sixth nodes.

Similar instances are recorded by Masters,[1] Worsdell,[2] Sabnis,[3] Singh,[4] and Singh and Sinha.[5] The abnormalities recorded in this plant are the presence of three cotyledons instead of normal two,[6] insertion of leaves and head,[7] leafy growth in the centre of the inflorescence and fasciation of capitula.[8]



The leaves described may be taken as the case of fission of foliar organs. According to the view expressed by Masters[1] "fission is due perhaps as much to the absence or relatively small proportion of cellular as compared with vascular tissue". This view is further supported by Goebel,[9] who has shown that there is a definite relationship between the shape and form of the leaf and its vascular distribution or venation. Hence the present abnormal leaves may be due to the plan of arrangement of the venation.

From the study of venation, phyllotaxy and absence of any sign of union in any part of the leaf, the leaves described may not be taken as the case of fasciation.

Bahauddin College,
Junagadh, G. A. KAPADIA.
April 1, 1943.

1. Masters, M. T., "Vegetable Teratology," 1869. 2. Worsdell, W. C., "The Principles of Plant Teratology, 1915, **1**. 3. Sabnis, T. S., *Journ. Ind. Bot. Soc.*, 1931, **10**, 22 4. Singh, T. C. N., *Ibid.*, 1930, **9**, 248. —, *Ibid.*, 1931, **10**, p. 135. —, *Ibid.*, 1935, **14**, p. 313. 5. Singh, T. C. N., and Sinha, B. N., *Ibid.*, 1928, **7**, p. 99. 6. Kapadia, G. A., *Journ. Uni. Bom.*, 1940, **8**, p. 125. 7. Parandikar, S. A., *Current Science*, 1933, **2**, p. 243. 8. Singh, T. C. N., *Proceedings of the 18th Indian Science Congress*, 1931, pp. 270–71. 9. Goebel, K., *Organography of Plants*, Part II, 1906, p. 338.

ON TERATOLOGICAL FEATURES IN SOME PLANTS

TERATOLOGICAL features are often taken as the basis for explaining various problems concerning the evolution of the floral parts. Many of the modifications are construed to be reversions to ancestral types indicating the primitive state. Many flowers of *Cucurbita maxima* collected by the author were found to be virescent. In the centre of the flower leafy structures with stalk and blade developed due to proliferation (Fig. 1) or the continued growth of the pedicel. Similar abnormal features have been noticed by Kausik (1938) in

FIG. 1
Abnormal flower of *Cucurbita maxima* Linn.

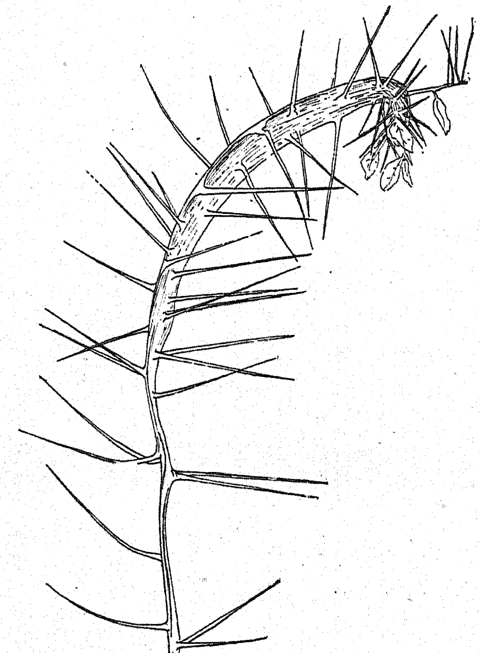


FIG. 2
Shoot of *Flacourtia sepiaria* Roxb. showing fasciation

Trichosanthes anguina, another member of the *Cucurbitaceæ*. In the male flowers the anthers which are usually synantherous had separated. The connate condition disappears and this phenomenon termed dialysis seemed to be a common feature in the malformed flowers.

The flowers of *Grangea madaraspatanensis* Poir are normally bright yellow. In many cases the floral parts become foliaceous and in place of the ray and disc florets small leaves were observed in the capitulum. This phyllody of the florets was accompanied by virescence of the petals, with the result that no patch of yellow colour could be observed in any part of the inflorescence.

Fasciation of stem was noticed in the case of *Flacourtia sepiaria* Roxb. The plant is a thorny shrub growing in waste places. Some of the branches had lost their prestine form and had assumed a flattened condition. The branchlets had fused and this was manifest by the position of the axillary spines (Fig. 2). Worsdell (1915) is of opinion that fasciation is the result of superabundant nutrition. Large number of buds that arise in close proximity develop simultaneously exerting mechanical pressure on each other, and become "grafted" together to form a single shoot.

Thanks are due to Dr. L. N. Rao for guidance and to Mr. M. J. Thirumalachar for helpful suggestions.

Dept. of Botany,
Central College,
Bangalore,
May 10, 1943.

K. S. GOPALAKRISHNAN.

1. Kausik, S. B., *New Phytologist*, 1938, **37**, 396-408.
2. Worsdell, W. C., 1915, "Principles of Plant Teratology."

THE GENUS *DRAPARNALDIOPSIS*[1] SMITH AND KLYVER

THIS genus was established in 1929 in America on the discovery of an alga by Smith and Klyver, who named it *Draparnaldiopsis alpinis*.[1] Besides this American species, the only other species, so far recorded, is *Draparnaldiopsis indica*,[2] which Professor Y. Bharadwaja described from Benares. The genus shows great specialization in its somatic organization among the Chættophoroales, of which it is one of the important members. It is on this account that Professor F. E. Fritsch, F.R.S., of the London University, selected *D. indica* Bharadwaja for the frontispiece of his classical book *Structure and Reproduction of the Algæ*.[3] Only the morphology of the two species was described, and the study of the reproduction and cytology was not attempted. The present writer has, therefore, made a detailed investigation, both in natural and artificial cultures, of the various stages in the life-history of the local species, *Draparnaldiopsis indica* Bharadwaja.

The alga possesses well-defined asexual and sexual methods of reproduction, effected by

means of motile swarmers. The quadri-flagellate macrozoospores, the quadri- and bi-flagellate microzoospores, and the biflagellate gametes have been recognised. The first two are invariably asexual in nature, whereas the more or less similar gametes from different plants fuse in pairs to form zygospores, which germinate directly to give rise to new plants. The reproduction of this plant is, therefore, similar to that of *Ulothrix zonata* Kützing[3] and *Fritschiella tuberosa* Iyengar.[4] The ecological factors determining swarmer-formation have also been studied. A complete account of the investigations in this respect has recently been published in the *New Phytologist*.[5]

A further study of the cytology of the alga is under investigation, but the data so far obtained show that there are two types of plants,—the asexual diploid plants possessing eight chromosomes and the haploid sexual ones bearing four chromosomes. The two types of plants are exactly similar to each other in external features and, therefore, *D. indica* Bharadwaja possesses an isomorphic alternation of generations.

Department of Botany, RAMA NAGINA SINGH.
Benares Hindu University,
March 10, 1943.

1. Smith, G. M., and Klyver, F. D., *Trans. Amer. Microsc. Soc.*, 1929, **48**, 196 *et seq.* 2. Bharadwaja, Y., *New Phytologist*, 1933, **32**, 1 *et seq.* 3. Fritsch, F. E., *Structure and Reproduction of Algæ*, Cambridge Uuiversity Press, 1935, p. 203. 4. Singh, R. N., *New Phytologist*, 1941, **40**, 170 *et seq.* 5. Singh, R. N., *Ibid.*, 1942, **41**, 262 *et seq.*

THE EXTERNAL GENITALIA OF *ALEURODIDAE*

In a previous note[1] published in this journal attention was drawn to the uncommon variety exhibited by the antennæ among the whiteflies. The external genitalia also present a certain amount of diversity of structure, which should provide a reasonable basis for a systematic revision of the group, based on the characters of the adult. Numerous morphologists like Muir,[2] Snodgross,[3] etc., have emphasized the importance of genitalia in the generic and specific determinations of several groups of insects; and the whiteflies appear to conform to other insects in this respect. The external genitalia of a male as a rule consist of a pair of parameres broad at the base, tapering and incurved distally. The aedeagus is also wider at the base, tapering gradually to its free end. A glance at the diagram will show the variability exhibited by the parameres as well as the aedeagus in some representative examples. *Dialeurodes trilobitoides* Q and B[4] (Fig. 1 *b*) seems to have an unmodified aedeagus which tapers gradually to its tip. In *Dialeurodes eugeniæ* Maskell near the distal end of the aedeagus there is a short cylindrical outgrowth (Fig. 1 *a*). *Taiwanaleyrodes indicus* Singh has a small conical protuberance close to the distal end (Fig. 1 *g*) and in *Aleurotuberculatus psidii* Singh there is a four-lobed outgrowth in the same position (Fig. 1 *f*). In *Aleurotuberculatus minuta* Singh and *Trialeurodes bicolor* Singh the tip of the aedeagus is curved and hook-shaped (Fig. 1 *d* and *e*). The aedeagus of *Aleurotulus maculata* Singh is bulbous and swollen distally with a fine jet at the end (Fig. 1 *h*). Lastly the aedeagus of *Dialeurodes glomerata* Singh is forked distally (Fig. 1 *c*). These characteristic features of the genitalia appear to be constant in the several individuals examined.

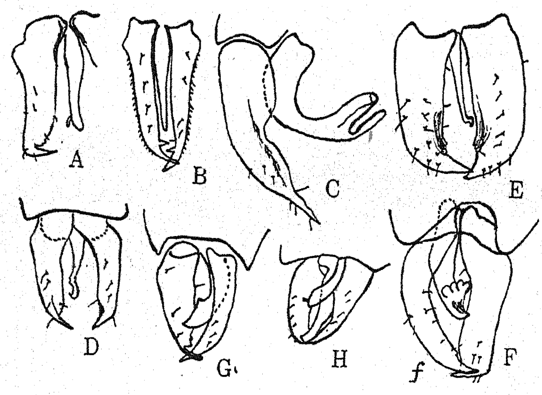


FIG. 1

The functional significance of this variability is difficult to comprehend. The parameres are employed to open out the valves of the ovipositor at the time of copulation, and the aedeagus for the transference of the sperms, and the variability of these structures may have some relation to the corresponding structures on the abdomen of the female; but no such variations have been noticed in the females which have been examined so far. Despite their unknown function, the systematic importance of these structures is obvious.

Dept. of Zoology,
College of Science,
Nagpur, KARAM SINGH.
March 18, 1943.

1. *Curr. Sci.*, 1936, **5**, 304. 2. *Pr. Hawaii ent. soc. Honolulu*, 1916, **3**. 3. Smithson, *misc. coll. Washington*, 1931, **96**. 4. *Mem. Dept. Agric.*, 1931, **12**, 28.

REVIEWS

Short-wave Wireless Communication including Ultra Short-waves. By A. W. Ladner and C. R. Stoner. (Chapman and Hall Ltd., London), 1942. Pp. xvi + 573. Fourth Edition. Price 35*sh.* net.

This latest edition of Ladner and Stoner's well-known book needs little introduction to students of Wireless. The first edition of the book appeared in 1932 and the fact that in the course of ten years, as many as four editions have come out with two or three reprintings for each edition, shows clearly the well-deserved popularity of this book. This fourth and "War-time" edition of the book is very welcome indeed as it contains a great deal of new material, though, as the authors themselves regret, "the exigencies of the times have prevented references to many new and interesting developments of short-wave and in particular ultra short-wave working".

The subject-matter of the various chapters is modified and a good amount of additional information given. Also, two new chapters have been added, namely, one on "Electron Oscillators" and the other on "High Frequency Therapeutic Apparatus", while two of the chapters in the earlier edition—those on "High Frequency Transmitting Apparatus" and "Ultra Short-waves" have been cut out and the matter contained therein have been included in other chapters. Thus, the behaviour of ultra short-waves instead of being treated separately, is considered side by side with short-waves as there are many features common to both. Another feature of the new volume is the rearrangement of the chapter sequence.

The first two chapters are more or less introductory in nature and deal with general items such as history of wireless, etc. The third chapter on "Modulation of High Frequency Waves" contains a lengthier elucidation of the principles of frequency and phase modulation than in the earlier edition. In the fourth and fifth chapters, the propagation of short- and ultra short-waves over short distances (direct ray) and through the ionosphere (indirect ray) are considered. Here some of the more elementary ideas on wave propagation have been cut out and a more detailed description of the ionosphere included. A notable feature is the mention—though it is very brief—of Contour Charts for estimating sky-wave field intensities, illustrated later in the appendix with practical examples.

The next two chapters are on aerials and aerial arrays. Here, in addition to other things, the properties of a quarter wave line as an impedance matching device as well as the use of the reactance transformer for the same purpose, are discussed and illustrated with practical examples. Mention is also made of feeder attenuation measurements, effect of insulator spacing on feeder attenuation and the velocity slip in feeders with a useful table for evaluating this last quantity for various typical feeders. In addition, a brief account is given of different types of feeders such as the four wire feeder system, feeders for television purposes and the properties of dielectric wave guides. In the chapter on Aerial Arrays, a brief description is given of a very important novel development due to the Marconi Company, for using Rhombic Aerials for transmitting purposes with efficiencies as high as 90 per cent. as compared with the usual low figure of about 40 to 50 per cent. for this type of aerial. This improvement is achieved by using a number of Rhombic antennæ connected in series, parallel or series-parallel arrays.

The rest of the chapters, namely, ninth to eighteenth, are more or less devoted to high frequency transmitting and receiving circuits. The chapter on "Power Amplifiers" gives useful information on the design of tank and output circuits and mention is made of the 'Inverted Amplifier' system developed by the Standard Telephone Company in their short-wave transmitters installed at the B.B.C. Elsewhere, in the book the quartz crystal oscillator is described in great detail as also the various types of recently developed electron oscillators such as those using the Electron Beam Deflection and the velocity modulated beam principles as well as the 'Klystron' Oscillator developed by R. H. and S. F. Varian.

Other additional information incorporated in the book includes the description of various recently developed systems of modulation such as the series modulation cathode follower and the cathode modulation systems as well as a very interesting description of one of the 100 K.W. Short-wave Transmitters installed at the B.B.C. The chapter on "Commercial Receivers" discusses in detail, among other things, the performance specifications of receivers and emphasis has been rightly placed on the fact that the overall gain of a receiver should be specified with reference to the *signal/noise ratio* as the inherent noise due to the shot and thermal agitation effects, sets a limit to the useful gain of a receiver.

The book concludes with a very fascinating chapter on High Frequency Therapeutic equipment.

While the additional information enumerated above is to be welcomed, it is to be noted at the same time that the authors have made only brief references to most of them. Though, in a book of this nature, it is inevitable if the size of the book is not to become unduly large, yet one cannot but feel that at least in a few places, a greater amount of detail should have been given, especially in those cases where published information is scanty or nil. Thus, in the case of the transmitting type of Rhombic Arrays developed by the Marconi Company, a detailed description of the design methods adopted should have been of very considerable value. Similarly, in the case of the Contour Charts for estimating sky-wave field strengths, mention should have been made of the method adopted in deriving these

charts. In the same way, a more detailed analysis could have been given of the attempted *quantitative* methods, if any, for correlating sunspot activity with F_2 layer critical frequencies and also the methods adopted for forecasting the latter quantity for various months and *latitudes* and for various distances.

There are practically no mistakes in the text except on page 231, line 4, where 'Principal' should be read as 'Principle'.

The new edition, as its predecessors, gives a number of very useful and recent references and there is no doubt that the book will be highly welcomed and valued by those interested in "Wireless".

K. V.

Science for the Prosecution. By Julius Grant, M.Sc., Ph.D., F.I.C. (Chapman and Hall, Ltd., London,) Pp. 302. Price 15*sh.* nett.

It is refreshing to turn to the part played by Science in the investigation of Crime at a time when what is uppermost in one's mind is the part it has played in the prosecution of wars. The book is not meant to be a treatise for reference by persons engaged in scientific work connected with unravelling of crimes nor is it meant merely to provide material for spending a few pleasant hours reading about the sensational discoveries resulting from the application of science to criminal investigation. The book strikes a happy mean between providing an adequate theoretical treatment to enable the reader to follow the principles on which such scientific work is based, and a narration of actual cases to the investigation of which the scientific method has made such valuable contribution. The book opens with a general chapter on the scientific approach to crime in which the author makes a powerful plea for the establishment of an independent medico-legal institute. The application of science to criminal investigation is then classified as consisting of (1) optical methods; (2) chemical methods and (3) blood group tests. The book closes with a chapter on Psychology and Crime.

The author himself is a distinguished worker in the field of fluorescence analysis and brings his long experience to bear upon his treatment of the subject. The brilliant work of Mitchell in regard to the age and classification of paper and writing materials, the work of Carter and Pollard on classification of paper and that of Professor Laurie in regard to finding the ages of works of art is referred to..

The cases mentioned make interesting reading. Questions pertaining to food adulteration are dealt with and it is indicated how in England the legislative measures "now constitute a true chapter of public food safety". The book will be altogether invaluable not only to scientific workers in the criminological field and to the Police Services, but also to the legal profession who can get an extremely adequate idea of the background of scientific work bearing upon criminal investigation.

One word may be said about the title of the book. The book is no doubt named *Science for the Prosecution* and in the race between the criminal and the forces of law and order there can be no doubt that scientific knowledge is an invaluable weapon in the hands with the latter. But in a country like India where, owing to various circumstances, scientific evidence adduced in courts is mostly on the prosecution side, the knowledge and guidance provided by the book of this kind will prove invaluable to the defence also.

A list of specialised treatises pertaining to the field increases the value of the book and greatly facilitates pursuit of any particular branch of scientific criminal investigation.

N. S. R.

High Frequency Thermionic Tubes. By A. F. Harvey, with a Foreword by Dr. E. B. Moullin. (Chapman & Hall Ltd., London), 1943. Pp. 235. Price 18*sh.* net.

The last few years have witnessed a phenomenal increase of interest in the application of ultra high frequencies to practical services such as television, frequency modulation, etc. This has stimulated invention, development and refinement of electronic tubes and circuits suitable for the several applications, of which the book under review gives a short account in six chapters.

After a brief general introduction in Chapter I on the function of electronic tubes as rectifiers, amplifiers, etc., and their feed-back characteristics, the author discusses in Chapter II the influence of the frequency of operation on the tube properties such as input and output impedances and mutual counductance. The limitation in their performance imposed by the finite transit time of electrons at frequencies above 20 megacycles per second and the consequent refinements introduced in tubes of the conventional types, are next discussed and various commercial receiving and transmitting tubes exhibiting a good performance beyond 20 mc./s. are described and illustrated. These include a comprehensive range, from the well-known 'acorn' type of miniature receiving tubes to the water-cooled transmitting tube RCA 888 giving an output of 300 watts at 200 mc./s. The latter half of the same chapter is very usefully devoted to the measurements of tube parameters at U.H.F. by the method developed by M. J. O. Strutt.

This effect of electron inertia has made possible the production of U.H.F. by an unconventional use of existing tubes or by the invention of tubes utilising different principles altogether. To the former category belongs the retarding field or positive grid generator discovered by Barkhausen and Kurz which is dealt with in some detail in the first half of Chapter III; the second half describes "the use of positive ion tubes as a means of studying conveniently effects which are appreciable with electrons only at frequencies so high as to preclude accurate measurements."

The second category includes the magnetron tube described in all its aspects in chapters IV and V which comprise a little under half of the book. Here the author has collected and organised in a thorough and well-balanced manner the fundamental and practical information regarding the magnetron such as the cut-off characteristics, oscillations in the

dynatron regime, the resonance regime and the electronic regime. This is only appropriate since for frequencies higher than 600 mc./s. the magnetron provides larger outputs than those so far reported (except by Klystron described later) and has been used at frequencies upto 30,000 mc./s. ($\lambda = 1$ cm.) a value well above that reported for any vacuum tube. In view of its comparatively simple electrode structure the magnetron would seem to lend itself easily to theoretical treatment, but it has always behaved in an unexpected manner and defied all explanations offered so far.

The demand for larger power outputs at U.H.F. resulted in 1939 in the development of the Klystron based on principles of electric resonators and velocity modulation of cathode-ray stream which form the subject-matter of the first part of Chapter VI. The reviewer cannot help feeling that it would have been more helpful for an understanding of these principles had the author devoted more space to develop and discuss these at a greater length instead of giving rather concise accounts of various publications. In the latter part of this chapter a readable account is given of the work of Barrow, Brillouin, Southworth and others on wave-guides and horn radiators for providing directional beams at U.H.F.

An important feature of the book is the bibliography at the end of each chapter, the total number of references being 517; a welcome change, in the opinion of the reviewer, is the use throughout of the word 'tube' in place of 'valve' in an English publication. The brevity of Chapter I has not contributed to the clarity of the statements with regard to the feed-back principle.

It will be sometime before we will be in a position to appraise the stimulus given to this vital subject by the present war conditions. We have heard of the Radio Locator and the Radar. In the meantime Dr. Harvey has done a great service by making an exhaustive and disinterested survey of a field in which developments have been so rapid that critical judgment must necessarily be held in abeyance for the present.

The volume contributes an important book of reference for every worker in this most fascinating branch of electron physics and communication.

N. B. Bhatt.

High Speed Diesel Engines. By A. W. Judge. Fourth Edition. Revised and Enlarged. (Messrs. Chapman and Hall, London), 1941. Pp. viii + 535. Price 25*sh.* net.

This book on "High Speed Diesel Engines" by A. W. Judge has run through another edition now, the fourth, and the author has taken advantage of this to make the book more up to date. This has resulted in an addition of 100 pages of more matter and a large number of diagrams. In recent years this book has come to be regarded as a text-book covering the entire field of the compression Ignition Engine in all its various applications and its value has been enhanced by these additions. The results of recent researches on fuel injection systems, the methods of cooling the nozzle and protecting it and recent methods of engine governing have been incorporated. New types of automobile and aircraft engines and two cycle engines have been added. Under engines of the Railway type details have been given of the latest railcar and locomotive types of C.I. engines and an account of the performance of the railcar or locomotive to which they are fitted has been given. The subjects of supercharging and altitude performance and the ratings of fuels have been considerably enlarged. One other noteworthy feature of the book is that some of the accounts of earlier engines and the fuel injection systems which are now obsolete, have been retained so as to make them available to the student and designer.

The treatment is on the whole excellent considered from all aspects, theoretical, practical or descriptive.

Lessons in Elementary Analysis. By G. S. Mahajani. Third Edition. (Aryabhushana Press, Poona), 1942. Pp. viii + 298. Price Rs. 6-4-0.

This well-known book by Prof. Mahajani, which has now run into a third edition, is a very well-thought-out one, and forms an excellent introduction to the subject of elementary analysis as taught in Indian colleges. The standard reached may perhaps be correctly described as lying between the Pass and Honours courses in the several universities. We are glad to note that several deficiencies that occurred in the previous edition (like Balakram's problem) have been omitted in the latest edition. The other changes like the proof of the second mean value theorem on integrals, the note on Frullani's integrals, a more careful treatment of uniform convergence, and the addition of a larger number of exercises have all enhanced the value of the book.

The chief merits of Prof. Mahajani's book are the extreme clarity and coherence achieved in the development of the subject. The author has modelled his book on that excellent "Cours d' Analyse" of De la Vallée Poussin, and succeeded admirably in imbibing its spirit, and following its methods. But this book is no mere copy of Vallée Poussin's, for the field and range of topics are different as also the outlook, and a lot of care, ingenuity and discretion have been used in writing a book with limited objectives but of the high standard indicated by Vallée Poussin's course of analysis. Special mention might be made of the excellent treatment of mean value theorems, Taylor's theorem and uniform convergence. The several notes and exercises have been carefully chosen and serve to illustrate clearly the difficult points involved in the immediately preceding theory. There is plenty of rigour but not such as to spoil the clarity of presentation at the elementary stage, nor is the book made too easy at the cost of rigour. A fine balance has been achieved, and the result is an extremely valuable elementary introduction to analysis.

There are, however, one or two points on which improvement is desirable. The introduction to integration through the notion of an area appears incongruous in a book which

is professedly rigorous. The area under a curve has no being apart from its definition as an integral, for, in Mathematics all being is of a logical character and hence area as a geometric intuition cannot be taken for granted. It would have been of great value to the student if a short introduction to the theory of integral had been appended, and also the distinction between primitive and integral (Cauchy or Riemann) dealt with more exhaustively. Again Ex. 3 on p. 83 should not have found a place in the book; it is characteristic of loosely written text-books which pay no attention to rigour.

These blemishes apart, we have no hesitation in recommending this book as an excellent introduction to elementary analysis.

K. S. K. AND B. S. M.

Wave-Mechanics. (Sukraj Rai Readership Lectures, 1939-40.) By V. V. Narlikar, (Patna University), 1942. Pp. vii + 160.

This account of wave-mechanics is based on a series of eight lectures delivered by the author, and presents a birds'-eye-view of the development of the subject and its broad principles. The topics treated are as follows:—classical mechanics, theories of Einstein and Bohr, Schrödinger's theory, transformation theory of Dirac, relativistic theory of the electron, theory of radiation and nuclear forces. The first seven chapters are of an expository nature while the remaining two chapters constitute a sort of report on the topics dealt with under them. The earlier expository part is in the historical order of development, *viz.*, classical mechanics, old quantum theory and the new quantum mechanics, and such a development has its own advantages as well as disadvantages. A historical treatment would perhaps have been inevitable in the earlier days of quantum mechanics when the theory itself was in a flux, but now that we have a sort of a satisfactory finished product it would be hard to justify such a treatment. In the three chapters on Waves and Particles, Matrices and Waves, and States and Observables, there is a repetition of ideas which has the danger of hiding the essential principles of wave mechanics under the mass of a number of alternative but equivalent mathematical representations. The distinction between non-relativistic and relativistic quantum mechanics is nowhere presented clearly in the book. Thus the postulates of the Dirac theory of the electron as given on p. 104 are definitely defective. Also the mention of the positron on p. 61 in company with a number of other collision problems which can be treated non-relativistically serves to give the wrong notion that the theory of the positron is also non-relativistic.

As the author himself admits the treatment in many places is "too sketchy and scrappy". As examples we might mention the following:—

(*i*) The treatment of group theory and group representations on pp. 148-52 appears superfluous inasmuch as no attempt is made to apply it even to a single problem. After giving this account of four pages in a book on Wave Mechanics it appears like an anti-climax to say at the end that "one of the most important applications of groups is in the study of crystallography".

(*ii*) The conclusion that the highest atomic number is 92 from the bare remark (p. 115) that "out of 136 possible rotations only 91 left the interaction term of two electrons unchanged" savours of Eddington's epistemological considerations, and can hardly be considered a proof.

(*iii*) The remarks (p. 123) on the nature of light are rather loosely worded. To the question "What is light, waves or particles?" the author returns the answer that it is neither. The correct answer, however, is that it is both since, according to the principle of complementarity, a complete description of natural phenomena may require the use of two points of view mutually contradictory. As regards the definition of light the author remarks (p. 124), "Those who know the mathematical theory can do without the definition which is not precise enough. Those who do not understand the theory will not be enlightened by the definition because it is too technical" This looks like unnecessary mystification, and gives an altogether wrong idea of the quantum theory of radiation.

(*iv*) The phrase "inside the electron" appears in many places in the book. This is perhaps a picturesque way of describing the neighbourhood of the nucleus, but it is rather loose terminology since it suggests that the electron is not necessarily a fundamental particle.

At the end of each chapter is found a list of references for further study, and this is bound to be of much value. But, surprisingly enough, we nowhere find a reference to Pauli's article on Wave Mechanics in the *Handbuch der Physik* which and Dirac's book are commonly considered to be the two best expositions of the general principles of quantum mechanics. We also notice "Yukawa" spelt as "Ukawa".

In spite of such imperfections we must confess we have enjoyed reading this book. In the earlier expository part, the author has successfully diagnosed the difficulties of beginners in quantum mechanics, and given full and clear expositions of these topics. The several summaries interspersed here and there in the book are bound to be of value to many students. The examples chosen to illustrate the theory are taken from out of a wide field and serve a very useful purpose. The book is written in a racy style abounding in analogies, and illustrations which serve to make difficult mathematical topics more easily understood.

V. R. T.

CENTENARIES

Webster, Noah (1758–1843)

NOAH WEBSTER, the American lexicographer, was born at West Hartford, 16th October 1758. Having taken his degree at Yale in 1778 and after spending about fifteen years in the legal profession, he found his vocation in the publication of the *American spelling book* of which more than 15,000,000 copies were sold in his life-time. He collaborated with Benjamin Franklin in spelling reform. After trying journalism for about a decade, he found a substantial income by publishing the well-known series of books *Elements of useful knowledge*.

Webster was versatile and covered a vast field of knowledge. His *Brief history of epidemic and pestilential diseases* (2 vols.) (1799) and his *Experiments respecting dew* (1809) were pioneer books in science in America. It is also claimed that Webster's work as statistician and climatologist foreshadowed the census and weather bureaus of later times.

Webster's many-sided publishing activity proved an admirable preparation for lexicography. He worked at his famous dictionary for twenty-five years and brought out the first edition in 2 vols. in 1828 under the title *An American dictionary of the English language*.

Webster died at Amherst, 28th May 1843.

Tweddell, Ralph Hart (1843–1895)

RALPH HART TWEDDELL, a British engineer, was born at South Shields, 25th May 1843. Even during his apprenticeship he took out a patent for a portable hydraulic apparatus to fix the ends of boiler tubes. The success of this led him to employ hydraulic power in boiler construction. In 1865, he invented a hydraulic riveting machine, which reduced the cost to one-seventh of hand-work. In 1871, he invented the portable riveter. This process came to be used all the world over for riveting bridges and ships.

In 1874, Tweddell's system was adopted in French shipbuilding yards. He contributed several papers on the use of hydraulic pressure and earned a gold medal from the Society of Arts. In 1890 he was awarded a Bessemer premium for the paper *Application of water pressure to machine tools and appliances*.

Tweddell died at Meopham Court, 3rd September 1895.

University Library,
Madras,
May 4, 1943. S. R. RANGANATHAN

SCIENCE NOTES AND NEWS

Animal Husbandry Wing Meeting.—The fifth Animal Husbandry Wing Meeting of the Board of Agriculture was held in the last week of November in New Delhi. The main subject discussed was measures to be taken to secure betterment of the large cattle population with a view to increase their produce required for human nutrition. The Conference took the view that by offering the producers increased price and an assured market, it will be possible to secure increased output of milk and ghee. An increase in price can to a certain extent satisfy the demand by drawing upon distant rural areas but considering the fact that a shortage of foodstuffs for cattle exists, possibilities in this direction will be rather limited. The fact that "India suffers from an excess of the animal population" was realised at the meeting and also that elimination of these animals "would confer a real benefit". However in view of the present public sentiments no effective remedy could be found for this major problem.

At the various sub-committees valuable practical suggestions regarding the control of cattle diseases, etc., in India were made. These measures when taken in conjunction with better feeding and breeding programmes, should prove very useful. With a view to make the veterinary education more uniform throughout the country and useful to the cattle industry of the country, a comprehensive curriculum was suggested.

In his opening remarks, the Hon'ble Member for Education, Health and Lands, suggested that the Conference should draw out an objective practical programme of work which may be taken up by the country during the next five years. This appeal has met with the response it deserved. A sixty-point programme has been drawn up and if a concentrated effort is made to put it in practice much good ought to result. One can only wish that this had come five years earlier. It will be too much to hope that this stupendous work can be seriously taken up by the State during the present emergency. It may, however, be considered a charter for post-war reconstruction.

This meeting of animal husbandry workers has given to the country a large amount of data

for the improvement of live-stock. It is hoped that some of these will be put in practice. At any such similar meetings in future, it will be useful if some time was devoted to review the practical results of the last conference. This will give a great impetus to workers in the field.

Mice which take in Cancer with their Mother's Milk.—Researches in recent years into the cause of cancer have clearly shown that a combination of factors is concerned with the initiation of the cancerous process in any one organ. In the case of the cancer of the breast in mice, workers in several countries, but especially in America, have shown the importance of a hereditary factor. By the method of close inbreeding (*i.e.*, by mating brother to sister in each successive generation) it is possible to produce after approximately twenty generations a strain of mice in which all the individuals resemble one another very closely in those characteristics which are capable of being inherited. Pure strains have thus been established varying greatly in the incidence of spontaneous breast cancer. At one extreme are strains in which all the females develop cancer of the breast while at the other extreme are strains in which the disease is completely absent. Cancer of the breast does not occur in males owing to the rudimentary nature of the organ in this sex.

It was expected that by cross-breeding it would be possible to show how the tendency towards cancer of the breast is inherited according to Mendelian laws. But experiment soon showed that when a female of high-cancer strain was mated to a male of a low-cancer strain, the resulting hybrid females developed breast cancer, whereas if a female of low-cancer strain was mated to a male of a high-cancer strain, the resulting hybrid females did not develop cancer. These observations led to the conclusion that some factor other than that contained in the chromosomes must have been transmitted by the high-cancer mother to the offspring, and it was natural to search for this factor either in the placenta, which nourishes the offspring before birth, or in the milk, which nourishes the offspring after birth. The demonstration by J. J. Bittner in America of a cancer-producing substance in the milk of high-breast cancer mice was done in the following way. The offspring of low-cancer parents were removed from their own mothers at birth and were suckled by high-cancer mothers; later in life nearly all of them developed breast cancer. By contrast, when the young of high-cancer parents were transferred to low-cancer mothers, very few of them developed breast cancer, although if suckled normally, nearly all could have been expected to be affected.

The milk factor is highly potent and very stable, for it can exert its effect when the young are suckled by a suitable mother for only a few hours and it can in turn be transmitted by these young to their offspring. Its essential nature is still unknown. Investigations are in progress in this and other countries by which it is hoped to link up the milk factor with the part played by hormones and other substances in the cause of cancer.

(*Monthly Science News*, No. 17, Dec. 1942.)

The Nutrition Foundation.—According to *Science*, 1942, 96, 490, a group of food and allied manufacturers in America, has contributed a sum of 1,100,000 dollars to support a five-year programme of basic research in the science of nutrition. The Board of Trustees of the Nutrition Foundation has discussed the allocation of these funds for basic research in leading universities throughout the United States. Additional grants-in-aid amounting to 46,000 dollars were appropriated; in all fifty-four grants were made this year to thirty-three colleges, universities and medical centres.

Illustrative of the type of studies being supported by the foundation under the direction of the director, Dr. Charles Glen King, and a distinguished Scientific Advisory Committee, are the following: Isolation of unstable food factors, protein utilization during partial starvation, utilization and distribution of radioactive iron, protection of the teeth afforded by specific nutrients, liver synthesis of blood proteins, nutrition protection against infection, the relation of vitamin A to muscle metabolism, nutritive value of low-cost vegetables, minimum vitamin needs of adults, metabolic balances in diabetes, nutritive protection of the blood vessels and the nutrients in cows' milk under specific conditions.

The programme made possible by the food industry represents the greatest nation-wide contribution to basic research and education that any industry has made in the history of America, according to Dr. King. He believes that the work of the foundation "will mean much in terms of better public health and an improved food supply in the United States and Canada". He pointed out that "significant results to aid in the war effort are already arising from research grants approved this spring".

A World Food and Agricultural Conference.—The United Nations Food and Agricultural Conference, which opens at Hot Sprins, Virginia, on May 18, will discuss the means to satisfy the basic needs of all nations.

The agenda recognises that in the past excessive accumulations of certain agricultural products were, in fact, not surpluses at all when measured by the world's minimum needs of food and clothing and that these so-called surpluses were usually the result of maldistribution and under-consumption.

Finally it examines the conditions which are necessary to assure that what can be produced moves into consumption.

Included in the agenda under the heading food, the Conference will discuss the character and extent of consumption and the deficiencies of each country, the causes and consequences of malnutrition and measures to improve the standards of consumption and reasonable national and international goals for improved food consumption.

Under the heading of other essential agricultural products, discussion will centre round

pre-war consumption level of various countries as influenced by prosperity and international goals for improved consumption with sustained employment and expanded industrial activity.

Dealing with the expansion of production and adaptation to consumption needs, the Conference will study measures for the direction of production toward commodities the supply of which should be increased, measures for the development and conservation of agricultural resources and opportunities for occupational adjustments in agricultural populations.

Some Aspects of Insulation.—This subject for the recent two Cantor Lectures of the Royal Society of Arts (*Jour. Roy. Soc. Arts*, 1943, 91, p. 122) covers two of the most important problems, which have been neglected so far, but which will have to be considered in any post-war planning. They are respectively Heat Insulation and Sound Insulation of buildings.

(1) The importance of thermal insulation has been brought home recently by increasing fuel shortage due to exigencies of the war. In this lecture Mr. Pallot points out the necessity of heat insulation in many industrial undertakings as well as community buildings as a single factor effecting the greatest saving in fuel. He confines his remarks to a temperature range of 100-400° F., thus covering all normal domestic heating requirements and industrial installations using steam at gauge pressures upto about 200 lbs. per sq. inch. Computations based on the theory of heat transmission show that in the case of hot water pipes and Lancashire boilers (8 ft. diam.) as much as 80 per cent. of the fuel-equivalent of heat lost can be saved by efficient insulation. Most of the saving is brought about by the first few layers of insulating materials like asbestos, magnesia, slag wool, etc., which have numerous air-cells to account for their properties. Crumpled aluminium foils held in rigid casing effect a large reduction in the heat lost by radiation. Even aluminium paint will reduce the radiation loss by 50 per cent. Methods of applying such materials and their economic thickness at various temperatures have been given. Attention is also drawn to the problem of heat insulation of buildings and useful data is given of the thermal properties of building materials in terms of their "thermal resistivity" and "thermal transmittance".

(2) The study of sound insulation is a part of the work now being undertaken by the Directorate of Post-War Building of the Ministry of Works and Planning of Great Britain. In this lecture Mr. Allen has referred mainly to noise abatement by planning and by structural techniques. Planning involves use of open spaces as a sound insulator consistent with the density of population and the city area to obtain reasonable conditions of the sound level in an average office room not exceeding 70 dbs. Other means are the use of barriers and height of buildings.

Our knowledge of the behaviour of air-borne and structure-borne sound has progressed enough to evolve structural techniques like suspended ceilings, floating floors and lighter walls and partitions to ensure the necessary degree of quiet by using such materials as quilts, cork, rubber, wall boards and felt. Internal location of the noiser parts to one side in a building is also important. All these can be achieved at a small additional cost but with a large reduction in the noise resulting in a greater degree of comfort and efficiency so as to warrant their widespread use at once.

N. B. BHATT.

Brazil and Indian Jute.—According to the *Chemical and Engineering News* for October 25, 1942, the farmers of the Amazon Valley have tried to cultivate not only ramie but also Indian jute. No practical results were obtained from seeds secured in either Sao Paulo or from Japan. The following year, seeds from India were employed, but the fibre produced did not show the same characteristics as the Indian product. In 1934, some good samples of *Corchorus capsularis* were raised. Since then plantations have been gradually improved and a crop of about 400 tons of fibre is expected this year.

"Juta dos Parintins" is the name given to the jute obtained in the Amazon Valley. Brazilian jute is similar in composition to that from India. The fibres are very uniform and have good tensile strength. With a whitish yellow colour, the fibres contain 71-72 per cent. cellulose, 12-13 per cent. water, and about 0·7 per cent. ash.

Producer Gas Buses for London.—According to the weekly, *The Engineer*, dated February 5, 1943, the London Passenger Transport Board has announced that a scheme for the use of 550 buses equipped with gas producers has been adopted for Central London. The scheme is expected to be put into operation before long. By using anthracite fuel, of which about one ton per week will be needed for each bus, corresponding to a radius of operation of close upon 80 miles before refuelling is required, it is hoped to save 3·5 million gallons of petrol each year. Some of these buses are already said to be in service on east London routes and according to the *Journal*, have given satisfactory operating results. In order to deal with this new scheme of transport operation, a new panel of public service vehicle operators has been set up. Part of the duty of the new panel will be to advise the Ministry of War Transport on the operation of producer gas vehicles on public service routes. Considerable experience has already been gained, both in England and in Scotland, with the operation of public service vehicles on producer gas, but the results of a large fleet of buses operating in Central London should prove of particular interest.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory, Bombay, during the month of April 1943, there were three of slight, three of moderate asd two of great intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin I.S.T.	Epicentral distance from Bombay	Co-ordinates of epicentre (tentative)	Depth of focus
		H. M.	(Miles)		(Miles)
1	Great	20 48	2970		..
5	Moderate	8 26	1490	Lat. 41°N., Long. 72°.5 E., near Samarkhand.	..
6	Great	22 37	10120	Lat. 33°.5 S., Long. 73°5 W., near Valparaiso South America.	..
9	Moderate	15 19	4810	Lat. 8°.5 S., Long. 138° E., near New Guinea.	100
11	Moderate	21 16	4490	..	..
12	Slight	10 44	3190	..	..
13	Slight	02 13	4290	..	..
15	Slight	18 05	10070	..	..

ANNOUNCEMENT

Dr. S. S. Aiyar.—We are glad to announce that Dr. Swaminath Subrahmanya Aiyar, B.A. (Madras), M.SC., Ph.D. (Wisconsin, U.S.A.), F.I.C., C.R.E.S., formerly for many years Chemical Examiner at the Custom House, Bombay, and recently Chemical Examiner at the Central Revenues Chemical Laboratory, has succeeded Dr. H. B. Dunnicliff, C.I.E., M.A. (Cantab.), SC.D. (Dublin), F.I.C., I.E.S., as Chief Chemist, Central Revenues Chemical Service.

We wish to offer our heartiest felicitations to him on this occasion. We should like to add that the Central Revenues Chemical Service now has an entirely Indian personnel, the first service in India to have this distinction.

Dr. H. B. Dunnicliff.—We are happy to announce that Dr. H. B. Dunnicliff has been entertained as Director in the Chemicals Directorate of the Directorate-General of Supply. The Government of India deserve praise for their foresight in requisitioning the services of such an experienced scientist and an able administrator for promoting the war effort.

Agra University.—Mr. R. Prasada, M.SC., Assistant Mycologist in the Scheme of Investigations on Cereal Rusts under the auspices of the Imperial Council of Agricultural Research, has been awarded the D.Sc. degree on a thesis entitled "Morphological and Physiological Studies in Rusts".

We acknowledge with thanks the receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 90, No. 4624; and Vol. 91, Nos. 4627, 4629, 4631 and 4632.

"Journal of Agricultural Research," Vol. 65, No. 11.

"Agricultural Gazette of New South Wales," Vol. 54, Pt. 2.

"Annals of Biochemistry and Experimental Science," Vol. 2, No. 4.

"Journal of the Indian Chemical Society," Vol. 20, No. 2.

"Journal of Chemical Physics," Vol. 10, No. 12; and Vol. 11, Nos. 1 and 2.

"Chemical Products and the Chemical News," Vol. 6, Nos. 3-4.

"Experiment Station Record," Vol. 87, Nos. 5 and 6.

"Transactions of the Faraday Society," Vol. 39, Pt. 1.

"The Review of Applied Mycology," Vol. 22, No. 1.

"Nature," Vol. 150, Nos. 3807, 3813, 3814, 3816, and 3817; and Vol. 151, Nos. 3820, 3821 and 3823.

"American Museum of Natural History," Vol. 51, No. 2.

"Journal of Research of the National Bureau of Standards," Vol. 29, No. 5.

"Canadian Journal of Research," Vol. 20, No. 12.

"Science," Vol. 96, No. 2500; and Vol. 97, Nos. 2505, 2506 and 2508.

"Indian Trade Journal," Vol. 149, Nos. 1921-24.

Books

Radio Receiver Design, Part I.—Radio Frequency Amplification and Detection. By K. R. Sturley. (Chapman and Hall, London), 1943. Pp. xii + 435. Price 28*sh.*

High Frequency Thermionic Tubes. By A. F. Harvey. (Chapman and Hall, London), 1943. Pp. viii + 235. Price 18*sh.*

A Treatise on Physical Chemistry, Vol I.—Atomistics and Thermodynamics. Edited by H. S. Taylor and S. Glasstone. (Macmillan & Co., Ltd., London), 1942. Pp. vii + 679. Price 42*sh.*

Marriage and Family in Mysore. By M. N. Srinivas. (New Book Co., Hornby Road, Bombay), 1942. Pp. 218. Price Rs. 7-8-0.

The Economic Background. By K. T. Shah, P. J. Thomas, J. C. Kumarappa, Sir Datar Singh and Sir Jehangir Coyajee. (Oxford University Press, Madras), 1942. Pp. 64. Price As. 8.

Prism and Lens Making, A Text-Book for Optical Glassworkers. By F. Twyman. (Adam Hilger, Ltd., London), 1942. Pp. iii + 178. Price 15*sh.* Postage 5*d.* extra.

ERRATUM

Vol. 12, p. 119, note entitled "Synthesis of Sulphanilamide Derivatives of Thianthrene", para 2, line 6: The melting point of the diamine *should be* 102° C. and *not* 120° C. as printed.

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CURRENT SCIENCE

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PADDY-CULTIVATION *CUM* FISH-CULTURE

SIR F. A. NICHOLSON,[1] in his 'Note on Fisheries in Japan', described how Japan was utilising its paddy fields for the culture of carps. He observed:

"The distribution of fry is gratis and is for a special purpose; in Japan it is customary in suitable localities to place young carp when one or two inches long, in the paddy fields in June when irrigation begins; by October, say four clear months, when the paddy is cut these have grown to 8 or 10 inches and are quite marketable; the rapidity of growth is due to the warmth, excellent feeding on minute crustacæ such as copepods, larvæ, etc., in the fields, from which, of course, they are kept from escaping by bamboo gratings. Should the water in the fields fail, the ryot digs a small pit in one corner in which the fish can survive till more water comes down. The rearing of the fish in the fields is said to improve the produce of the paddy since the fish destroy many insects injurious to the plant." (Pp. 86-87.)

He further observed:

"On the subject of the growth of carp in paddy fields Prof. Mitsukuri says that in a single village the agricultural society (a point worth noting) represents the *whole* village, utilises 250 acres of paddy fields each year for this by-product, and annually breeds 25 million fry to be sold and raised in surrounding villages. He mentions another case where a vast area is irrigated (as in Egypt) by inundation, and the culture of carp in this area, though in its infancy, realised in 1902 no less than Rs. 72,000." (P. 87.)

In making suggestions for the improvement of fisheries in India, Nicholson (pp. 100-101) regarded paddy fields as suitable grounds for fish culture, especially in the deltas where the water-supply is almost unfailing. Thus vast areas of Bengal are particularly suited for the simultaneous cultivation of paddy and the culture of carps.

In considering the question of paddy *cum* carp culture, it is essential to remember that though the yield from individual fields may not be great, the aggregate produce would run into several millions of pounds. This experiment can be conducted at practically no cost except that of obtaining the fry, while if villages do so on an extensive scale on co-operative basis, thereby reducing the individual expenses, the income from this by-product would be considerable. Mitter[2] has calculated that if the acreage in Bengal under rice crop (2,292,100 acres) and jute crop (2,310,300 acres), which require water almost all the time during the season, were to be utilized for the culture of fishes and if the average yield from the fishery were to be calculated at a modest sum of Rs. 10 per acre an annual additional income of nearly 5 crores of rupees could be derived from these sources.

In his popular note on 'Carp-Growing in Germany', Nicholson[3] made reference to this subject again and suggested the culture of carps in the vast areas covered by paddy fields in Madras.

Though references to the great possibilities of paddy cultivation *cum* carp culture are contained in the writings of several later writers[4] on Indian fisheries, no one appears to have recorded this practice from

any part of India. It is a matter of great pleasure, therefore, to report that in parts of the Sundarbans use is being made, though at present to a very limited extent, of the paddy fields and khals in the Abad areas for the culture of common Indian carps. Before describing the practice as prevailing at present, it is necessary to say a few words about the genesis of the Abad areas.

It has long been realised that detaic action has given rise to a network of deep creeks in many areas in South Bengal, particularly in the Sundarbans. In view of the heavy rainfall and the rise and fall of the spring tides in these regions, a network of deep khals is developed for the draining of the receding waters. In the process of colonisation, it is necessary to make embankments right round the area to be colonised so as to prevent the salt-water flooding the land. For this purpose a number of creeks are also dammed across by massive bunds (embankments). These creeks are sometimes over 25 feet deep, 100-200 feet broad, and several miles long, and by putting in sluices at the river end they are used as drainage canals for the embanked areas. Certain low parts of the embanked land are flooded with salt water and the young of river fish are taken in and allowed to grow for 8 to 9 months till they attain a marketable size. Then about November-December, the fishery is dewatered and the fish are either trapped or netted. Gradually when the higher lands in the embanked portions lose a part of their salinity through the action of the rains, and this happens in two or three years' time, they are put under paddy cultivation. So at one stage the *khals* with brackish waters are used for the cultivation of salt-water fishes while the neighbouring fields properly embanked are used for paddy cultivation. With the salt-water fisheries there is always a danger to the embankment, for snakes, eels, crabs, etc., cause immense damage by tunnelling through them. To avoid this heavy loss month after month, the brackish water fisheries are usually discarded and more lasting embankments are put up for the collection of fresh water. Not very long ago these creeks or drainage canals were not utilised in any way though the fields alongside them were used for the cultivation of paddy.

I am informed that about fifteen years ago, Babu Priyanath Sao of Suryapur, now living in Gurguria, while on a visit to Midnapur, where the carp fry are available in abundance, happened to purchase eight annas worth of very young fry and brought them to his place in the Sundarbans in a small pot. These he liberated in a small pond near his homestead and when the fry attained a size of about two inches, he transplanted them into another larger pond. These were liberated in the month of Asar and Sraban (July and August); when ten months later, he caught those fishes, to his great surprise Catla had attained a size of about seven seers, and Rohu about five seers.[5] This encouraged him very much and the news spread all over the neighbouring Abads and the people then thought of seriously taking up carp culture as a profitable proposition in their creeks alongside the paddy fields. Now these fish are cultured in several of the creeks and it has been reported that they have bred naturally in some of these canals. However, the dealers in carp fry now go from Abad to Abad during the stocking season and the people are taking to carp culture as a subsidiary means of making some extra money. It is a pity that the evil practice of stocking fishery areas with very young fry is also prevalent in these Abads and in some cases, therefore, the results are not very satisfactory. For the present only tanks and ponds are generally stocked but in certain cases these are connected with paddy fields during the season so the fishes roam about over vast areas.

The breeding of carps in these estuarine parts of Bengal may seem rather strange, because from the information so far available carps have only been known to breed in large rivers with swift currents during floods when the neighbouring paddy fields are covered with flood-waters and the brood fishes leave rivers and enter the shallow and warm waters.[6] As indicated above, the deep creeks in the cultivated areas in the Sundarbans and the high lands where the paddy fields are situated, provide an exact parallel to the conditions which prevail in the artificial breeding grounds of carp in places like Midnapore[7] and Chittagong.[8] There is every probability, therefore, that the carps may have bred in these parts, though it has not definitely been ascertained so far.

From the rate of growth and the ease with which these fishes have been cultured in

these parts, it seems evident that there is a great possibility of developing carp culture in the Abads. As it is a relatively new venture in these parts, it is essential to organise it along proper lines. In the first place, it must be made clear to all pisciculturists to stock their tanks only with fry of reasonable size so as to avoid the introduction of predaceous fishes, such as Boal, Saul, Chital, Phaloi and others. It was brought to my notice that in one of the tanks, where inadvertently a Boal had been introduced, out of about 15 seers of fingerlings only thirty carps were netted, while a Boal of about 4 to 5 feet long was also taken from the tank. This explained the cause of failure of this crop of carps.

With regard to the rapid growth of fish in these waters, it must be remembered that in the beginning, when the water is slightly brackish, there are plenty of shrimps, prawns and abundance of planktonic organisms, and Catla and Rohu feeding on them grow at a fairly rapid rate. When the water becomes almost fresh, then vegetation appears which consists of water-lilies, Samna grass and various types of Jhanjis and Panas. However, the growth of the fishes is not to be ascribed only to the abundance of food but also to the long runs they have in the creeks and the adjoining paddy fields which generally swarm with microscopic life. Thus in the Sundarban Abads we have extremely favourable conditions for paddy *cum* carp culture.

At the time of paddy harvesting it is necessary to dewater the paddy fields and at this time either the fishes are marketed or they are allowed to congregate into the deeper channels or the creeks referred to above. After the paddy is harvested, the dry season having commenced, the lands are left fallow for the cattle to graze on while in suitable areas vegetables or other short-term crops are raised.[9] On the rush of monsoon all cattle refuse in these dry portions is carried into the deeper channels and provides manure for the growth of fishes. In pisciculture it has been found necessary to allow piscicultural areas to dry up and as noted above in these Abads this is almost a necessity at the time of harvesting paddy. It will thus be seen that most ideal conditions exist in these Abad areas for the cultivation of paddy and the culture of carps simultaneously.

Attention may here be directed to the practice of prawn culture in paddy fields along the Malabar Coast in North Travancore.[10] The paddy fields adjoining the backwaters and at a somewhat higher level are cultivated only once in the year from July to October when the water in them is fresh. The paddy is harvested by about the end of September and then the same fields are used for the culture of prawns. The flooding caused by the October-November rains is often allowed to keep the backwaters in direct communications with the paddy fields, but after the monsoon and with the lowering of the water-level the communications are restricted and during high tides brackish water, along with the young of prawns, is allowed to get in freely through sluice gates in the embankments into the paddy fields. By judicious manipulation fresh water is drained out occasionally and brackish water taken for some months into the paddy fields so the salinity of the water in the paddy fields goes on raising. The fishing for the prawns starts after two to three months of stocking (end of December or early in January) and lasts for several months. The rains of the south-west monsoon wash out the salinity from the fields and make them suitable once again for paddy cultivation by about July.

In places where "Bhasa Bada" fisheries in the Sundarbans adjoin paddy fields or fresh-water canals, mullets and prawns, especially Bagda Chingri, are allowed access into fields and canals for they are known to fatten well under fresh-water conditions usually in the second year of their growth.

Mr. H. S. Majumdar, Agricultural Officer, Gosaba (24-Parganas), has kindly made the following suggestions from his practical experience.

In suggesting the cultivation of fish along with paddy, attention may also be paid to the following important factors:—

(*i*) Owing to the continuous movements of the fishes, planted in the paddy fields, the tillering action would be increased due to disturbance of the mud and the weeds. As is well known, Carps eat Jhanjis, other soft weeds and the insects which drop from the crops due to their movements or by the breeze.

(*ii*) The paddy crops benefit from the excreta of fishes, which serves as manure.

(*iii*) Due to the sound from the paddy crop caused by the movement of

the plants and by the breeze, fishes run about which is healthy for their growth.

If the fish thus reared as a by-product are sold in the month of October, that is, after four months of cultivation, at least fifteen times profit on the purchase value would be made. But if the fish are transferred to a big pond, or if trenches are dug around the paddy fields and the fish preserved in them for a longer period, much greater profit could be made.

The cost of digging trenches in the Abad areas is negligible in comparison with the benefit that would be derived from stocking fish in them. The earth excavated for making these trenches would serve the purpose of making strong bunds. These bunds can be utilized for high land crops, vegetables and other trees which would provide the cultivators with another means of earning and also control the water in the fields which would be helpful for cultivation of crops and fishes.

The trenches could be utilized as reservoirs for the irrigation of vegetable and paddy crops, when necessary. They can also be used to drain out water from the fields, if required, and would not allow the field rats, cattle or thieves to enter the fields and cause damage to the paddy crops.

These trenches would serve as places of retreat for the fishes, and can also be used for the cultivation of deep-water 'Aus' and 'Aman' paddy.

The bunds would prevent the wasted away silt to get deposited in the trenches. The bottom mud from the trenches would serve as a good manure for paddy fields.

The trenches if covered by bamboo shades, may be used as support for the creeper vegetable plants, such as kumra, cucumber, etc.

The poor cultivators may take advantage of these suggestions by mutual co-operation if they find it hard to do it individually.

In a recent communication, Dr. Herbert H. Brown, Director of Fisheries Investigations, British West Indies, made the following interesting observations on the possibilities of fish-culture along with agricultural crops in British Guiana:

"In British Guiana, the intensely cultivated alluvial coast lands under sugar and rice are irrigated by a complicated system of canals and trenches; for every square mile of cane cultivation there exist 16 miles of irrigation canals 40 feet wide, 4 miles of drainage canals also 40 feet wide and 45 miles of 4 feet drains. Flood fallowing for periods of six months to a year is a standard practice, and this and the rice padi fields afford further considerable acreage under water and entire mechanical control. These canals are assiduously fished and when a flood-fallowed field is drained there is often a general scramble for the fish left stranded. My suggestion is that these areas under water could be made much more productive by stocking with fingerlings of indigenous fish reared in hatcheries in order to supplement the natural rate of reproduction, and to meet the heavy fishing load. This would be coupled with management of the fishing load by such measures as temporary closures and control of gear. There is a brief description of this canal system in the *Agricultural Journal of British Guiana,* Volume 9, No. 4, pp. 201-202, December 1938.

"Although the culture of fish on these lands should be profitable, I put forward these suggestions for stocking and fishery management not only from a revenue-producing standpoint but in the interests of public welfare, with the object of making available significant amounts of animal protein to labouring populations whose diets are generally deemed to be deficient in animal protein. At least 40 per cent. of this population are immigrants or their descendants from India."

It will thus be seen that under the stress of war and with a view to "Grow More Food", all suitable water areas are being stocked to make them much more productive. It is hoped that in India also this aspect of fish culture will receive due consideration at the hands of the agricultural and fisheries authorities.

SUNDER LAL HORA.

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1. Nicholson, F. A., *Bull. Madras Fish. Deptt.*, **1907, 2,** 86, 87, **100**, 101. 2. Mitter S. C., *A Recovery Plan for Bengal*, 1934 Calcutta, **243**. 3. Nicholson F. A., *Bull. Madras Fish Deptt.*, **1917**, **11,** 158. 4. Gupta, K. G., *Reports on the Results of Enquiry into the Fisheries of Bengal and into Fishery Matters in Europe and America* 1908, Calcutta, **102**. Director of Fisheries, Madras, "Pisciculture", *The Allahabad Farmer*, **1933 7,** 1 3; Mitter, S. C., *A Recovery Plan for Bengal*, 1934, Calcutta, **243**; Mazumdar, C. H., *Financial Times*, 1939, December, 4. 5. This would seem incredible, for in an average good tank Catla grows to a seer and a quarter and Rohu to somewhat less than a seer in the course of a year. However, extensive and careful enquiries made in the Abad show that the rate of growth reported by Babu Priyanath Sao is not improbable. I had a tank netted at Gurguria where Pona fry had been liberated about four months earlier and found that Catla had within that short period attained a weight of 1¼ seer and Rohu about 7/8 seer. 6 Khan, Hamid, *Jour. Bom Nat. Hist. Soc.*, 1942, **53,** 416–27. Das, B, *Proc. Ind. Assoc. Cult. Sci.*, **1917 3,** 6 21. Ghose, A., and Ghosh, N., *Bull. Dept. Fish. Bengal*, 1922, **18,** 3–8. 8. Mazumdar, C. H., *Science and Culture*, **1940, 5,** 735–38. 9. The raising of short term agricultural crops alternately with fish culture is considered very desirable by a number of authorities, such as Prashad, B., *Bull. Deptt. Fisheries, Bengal and Bihar and Orissa*, 1919, **13,** 4; Lal, Chaman, *The Modern Review*, December 1942, 472. 10. Panikkar, N. K. *Journ. Bom. Nat. Hist. Soc.*, 1937, **39,** 343–53.

THE ECONOMIC ASPECTS OF STATE GEOLOGICAL SURVEYS*

BY

CYRIL S. FOX

(*Director, Geological Survey of India*)

THE old fashion belief that a State Geological Survey was more ornamental and academic than practical and useful has, I think, nearly disappeared as a result of the work carried out by the Russian Geological Survey under the drive for industrialisation by the Soviet Government. In the Union of Socialistic Soviet Republics, scientific training and equipment has not been spared in the continent wide search, exploration and exploitation of ore deposits and mineral occurrences for materials for the metallurgical and other industries in Russia. However, elsewhere in Europe and in America there remains a considerable difference of opinion as to whether a Geological Survey should extend its operations into the sphere of experimental investigation to demonstrate, on a semi-commercial scale, processes for the treatment and the preparations of ores and minerals.

In the case of the Russian Geological Survey, the work covers the entire field from routine mapping, care of the museums and educational details for training personnel to prospecting and development operations, to advisory appointments, for problems of engineering geology, metallurgical matters, questions of oil research, geophysical investigations and experimental work. In the United Kingdom, the Geological Survey of Great Britain has less to do with practical mineral development, but specialises in field mapping, questions of water-supply and in exhibiting beautiful mineral and similar collections. Similarly, the Mines Department in Great Britain is almost entirely used for the administration of the Mining Rules for effecting safety in working the mines.

The Department of Mines in Canada contains two branches—(*a*) the Geological Survey branch based on the English pattern, and (*b*) the Bureau of Mines branch which is essentially an experimental research organisation. In the case of the United States of America where they have two separate organisations—(*a*) the Geological Survey and (*b*) the Bureau of Mines, both on an even far more elaborate plan than their equivalent organisations in Canada—(*a*) and (*b*) are controlled from two different Departments of the United States Government. The Geological Survey of the U.S.A. has a special Hydrographic Branch and also include the Topographic Survey in addition to its work on mineral surveys and museum collections.

The Geological Survey of India has its nearest counterpart in the Russian Geological Survey, which existed before the Soviet Government assumed control and expanded its activities to include all the work which is conducted by the Canadian Department of Mines, and much more besides. From its initiation in 1846, the Geological Survey of India has operated for the purpose of developing the mineral resources of this country, and has operated mines as well as conducted investigations on minerals, ores and related substances with a view to their utilisation. Previous to 1902, mining and metallurgical specialists were recruited for the Geological Survey of India to enable this Department to carry out its operations in field geology as well as in mineral developments.

In 1902, the mining and metallurgical specialists of the Geological Survey of India were utilised to be a nucleus to the newly formed Bureau of Mines Inspection, which is the Indian Mines Department and based on the English model chiefly as an Inspectorate. The Geological Survey of India was thus robbed of the mining engineers and metallurgists who provided the experts for actual mineral development after the exploratory surveys had located the minerals of economic value. Although the loss of this mining personnel was painfully evident when the Indian Munitions Board came into being in 1917, this defect in the cadre of the Department was not remedied, when a post-war re-organisation was carried out in 1922. Indeed the Geological Survey of India was almost brought into line with its opposite number in Great Britain.

The two steps, that of creating the Mines

* Substance of a lecture delivered before the "All Bengal Economic Conference" held in Calcutta on 12-4-43; specially contributed by the author to *Current Science*.

Department in 1902 on the English model, and that of not introducing a true Bureau of Mines on the Canadian pattern when the re-organisation was made in 1922, reduced the Geological Survey of India from an organisation for mineral development as its objective to a department whose chief objective was to complete the geological map of India. This was equivalent to having an architect to prepare drawings of a new building or a new city, without having the plans and estimate passed and engineers engaged for the actual constructional work. Some effort was, however, made to help in mineral development, but the Geological Survey was not staffed nor properly equipped for any serious work of this kind and when mineral development became a Provincial subject in 1937, no corresponding field parties were formed for special assistance to the local Governments.

With the threat of war in Europe quite evident in 1938, and the lack of a technological organisation on the lines of the Canadian Bureau of Mines keenly felt, an effort was made to at least restore the Geological Survey of India to the position it held previous to 1902. This was partly effected in 1939 and 1940, and improved somewhat in 1941, when the sulphur operations at Sanni and in Koh-i-Sultan were initiated and other explorations were undertaken in Madras and elsewhere. The establishment of an Utilisation Branch of the Geological Survey of India in 1942, however, completely restored the position of the Department, and permitted operations to be undertaken with specially recruited mining engineers and metallurgists. The chief exploration in progress is that of re-opening one abandoned lead-zinc ore mines at Zawar, Udaipur, Rajputana.

It is necessary to point out at this stage that no provision has yet been made for an experimental or demonstrational, technical organisation which might be the equivalent of the Bureau of Mines in Canada or that in the U.S.A. It is quite erroneous to consider the Utilisation Branch of the Geological Survey of India as in anyway the initiation of an organisation even resembling the Canadian Bureau of Mines. In its present form the Utilisation Branch is simply an expansion of our prospecting operations, so that we are proving the sulphur deposits in Baluchistan, exploring the lead-zinc ore lodes in Udaipur, operating some mica mines in Monghyr, encouraging the search for rare minerals and endeavouring to procure wolfram from discouragingly small occurrences. A start has also been made to examine certain old tin and copper mines.

Except for beginning a geophysical investigation of a manganese ore deposit and continuing this kind of exploration to the mica-bearing pegmatites, there has been no organised experimental research. Personal efforts have been made for refining the Baluchistan sulphur rock, but this is now regarded as outside the scope of the Utilization Branch. I have conducted a research on the electrical properties of the muscovite micas of Bihar and Madras, and continuing these investigations in examining the sparking plugs and electrical condensers, using mica, in our aircraft. In the past few months we have also experimented with the preparation of tungsten trioxide from wolfram, the conversion of non-caking into coking coals, the production of smoke haze screens, the use of various coloured earths and ochres for camouflage, etc. However, all these are individual rather than departmental researches.

I think it can be safely said that the activities of the Utilisation Branch are more closely connected with the normal operations of an energetic Geological Survey than those which might be expected from an established Bureau of Mines. It would, in my opinion, be a folly as great as that of 1902, if the working of the present Utilisation Branch was separated from the Geological Survey. There is no doubt that mining operations should be conducted by qualified mining engineers, just as drilling for oil should be carried out by the most skilled drillers. This does not separate oil-drilling from oil-geologists. I think every oil company of any importance recognises that their success depends on the guidance of their geologists. To believe anything different in the case of ore or mineral explorations is to court trouble to say nothing of unnecessary expense.

I am the first to admit quite frankly that there is an immediate need for an organisation like the Canadian Bureau of Mines in India, but it will be prudent to establish it as a new institution and later make adjustments between this Minerals Research Branch and the Utilisation Branch of the Geological Survey. I agree also that the Minerals Research Branch of the Bureau of

Mines can be quite separate from the Geological Survey, but this is not true of the Utilisation Branch as it is at present. It is actually a part of the Geological Survey and no adjustment can be made until a properly planned Bureau of Mines or Minerals Research Branch is operated. The geologist may take a back-seat when a mining engineer drives, but the driver will often require guidance and even instructions from the back-seat geologist. The responsibility always lies with the geologist, while praise usually goes to the engineer.

It is of interest to know that the number of geologists on the staff of the Burma Oil Company in Burma was about three times that of the Burma Geological Department. There were reported to be no less than 6,000 geologists in the employ of the Soviet Government in 1937, indeed the number was given to me as roughly 10,000 geologists. On a comparative estimate the Geological Survey of India should have about 600 geologists but even on the basis of one geological officer to every district in India, the number is roughly 300 as against about 60 at present employed, many of whom are on a temporary understanding. It is difficult to convince the Government of India that even 150 official geologists are actually necessary for a thorough search of India for minerals which are now regarded as of economic importance. If, however, sanction was accorded for this number of suitably qualified geologists, it would be practically impossible to procure them in India.

There is already difficulty in recruiting Indian geologists who have experience enough and the requisite qualifications to undertake responsible work. Indeed we have had to resort to the expedient of employing post-graduate scholars, fresh from various colleges, etc., as Geological Assistants on a nominal salary and give them field training and experience under special officers. The problem of future recruits is so serious that I recommend it should be taken up with the various centres where geology is taught in India in order that some arrangement is made with the advice of the Geological Survey of India for meeting the demand which already exists. As a further measure of prudence, I would advise the employment of at least 12 experienced European geologists, who are in India as evacuees, on the Geological Survey in order that young Indian geologists may work under their guidance. This is because we are so short handed.

In conclusion it may help to an understanding of the position if I show that since 1846 there have been about 120 geologists on the staff of the Geological Survey of India and that the average field service of these men has been about ten years, while the annual work done by each geologist in mapping is roughly 500 square miles. This means that an area of about 600,000 square miles should have been surveyed in fair detail in India and Burma in the past ninety-seven years, or about one-third the total area involved. Although there are extensive areas of alluvium, there are also areas in which the geology is very complex, so that an average of 500 square miles is not to be misunderstood. It is a question therefore whether it is not better to search the country quickly and thoroughly by employing a larger staff or simply going on in our present rather old fashion way.

CALCUTTA,
March 16, 1943.

SCIENTIFIC DISCOVERY

If there is one fact which stands out more than any other in the history of science, it is the remarkable extent to which great discoveries and youthful genius stand associated together. Scores of instances can be quoted in support of this proposition. The fact of the matter appears to be that, other things being the same, the principal requisite for success in scientific research is not the maturity of knowledge associated with age and experience, but the freshness of outlook which is the natural attribute of youth. The conservatism which develops with increasing age is thus revealed as a factor which militates against great achievements in the field of science. The principal function of the older generation of scientific men is to discover talent and genius in the younger generation and to provide ample opportunities for its free expression and expansion.—From a broadcast by SIR C. V. RAMAN. (Courtesy of *Indian Listener*.)

THE ORIGIN OF THE "ROHR" OR ANHYDROUS SODIUM SULPHATE BEDS BELOW THE SALT PANS AT DIDWANA

BY

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(Technical Adviser, Messrs. Bird & Co., and F. W. Heilgers & Co., Calcutta)

In the January issue of *Current Science*, Dr. Dunnicliff[1] describes these Didwana sulphate deposits and explains their origin by separation of the decahydrate from the pan brine during the early colder period of the salt season, and the subsequent transformation of this decahydrate to the anhydrous salt. During a recent visit to this area I had the opportunity of examining the sulphate beds and of seeing something of the conditions under which they must have been laid down. It appears to me that an alternative explanation of their origin can be put forward, more in harmony with the facts.

Quality and Quantity

Before discussing the origin, I would like to stress the remarkable freedom from sodium chloride of these "Rohr" deposits, especially if one remembers that they have originated by crystallisation from a solution containing three times as much chloride as sulphate. Up to the present time 200-300 tons of this material have been consumed by the Titaghur Paper Mills and this has all been carefully sampled wagon by wagon and analysed. The following figures indicate the average quality of this 200 tons:

	1	2	3	4	5	6	7	8
Moisture	0·15	0·15	0·10	0·20	1·13	0·88	1·82	0·74
Insolubles	5·26	4·66	6·70	5·65	11·89	5·37	6·06	9·42
Sodium sulphate	92·2	92·44	89·9	91·9	85·3	92·65	90·17	86·93
Sodium chloride	0·23	0·46	0·53	0·80	0·45	0·53	C·26	1·17
Sodium carbonate	0·21	0·10	0·10	0·10	0·21	0·16	0·22	0·17
Sodium bicarbonate	0·34	0·59	0·42	0·42	0·42	0·42	0·34	0·42
Iron and Alumina (as sulphates)	0·56	0·28	1·12	0·56	ND	ND	ND	ND
Calcium sulphate	0·36	0·24	0·24	0·24	ND	ND	ND	ND
Magnesium sulphate	0·30	0·30	0·45	0·30	0·30	0·30	0·40	0·45
	99·59	99·22	99·55	100·17	99·7	100·31	99·47	99·35

It will be seen that the average sodium chloride content runs well below one per cent., even on a basis of "silt free" material. It may be that the "Rohr" excavated from subsequent pan beds will contain more chloride, but this does not seem likely, since the above analyses probably represent a fair average of the 5,000 tons of "Rohr" excavated so far from four pans opened up. I understand that there are in all about 250 salt pans, and if these produce the same relative amounts of "Rohr" as the four pans excavated, there should be something in the order of 250,000 tons available at Didwana.

At the time of my visit a bed of "Rohr" two to three feet thick was exposed in one of the partly excavated pans. This bed consisted of massive interlocking crystals of the anhydrous sulphate "Thenardite".

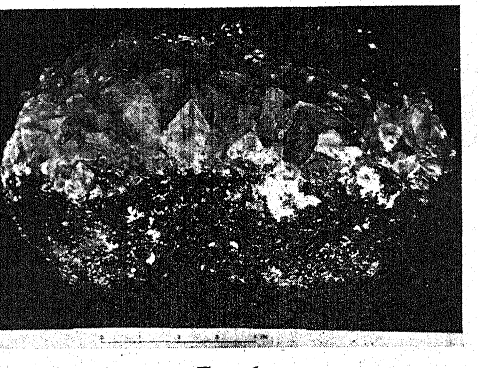

Fig. 1

Specimens were obtained showing clusters of undamaged glass-clear crystals with individuals up to two inches in length and breadth. These are shown in the attached photographs. The crystals belong to the Orthorhombic system and are pyramidal, the principal face being a pyramid probably the Unit Pyramid (1.1.1).

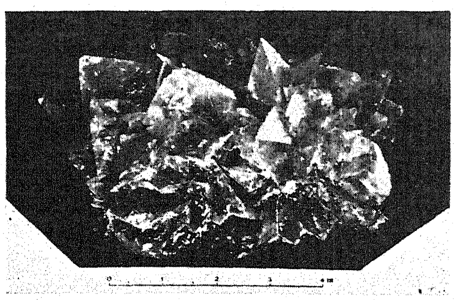

FIG. 2

ORIGIN OF THE DEPOSITS

According to Dr. Dunnicliff these "Rohr" deposits have been derived from crystallisations of the decahydrate ($Na_2SO_4 . 10\ H_2O$) during the early cold weather period, when the pans are first filled with the well brine. The assumption is that during this period the temperature falls below the transition point for Na_2SO_4-$Na_2SO_4 . 10\ H_2O$ and that the decahydrate (Glauber's salt) then crystallises out. In order to understand this process and its implications, it is necessary to know something of the relative solubilities of sodium chloride and sodium sulphate and the effect of the chloride on the transition temperature of the sulphate.

Solubilities.—The solubility of sodium sulphate (in the absence of sodium chloride) is fairly high but varies rapidly with the temperature as is indicated by the figures given below:[2]

Temperature	Solubility
40°F.	5%
60°	15%
80°	35%
90°	48%
93·2°	55%
100°	50%

Sodium chloride progressively decreases the solubility of the sulphate as is shown by the following solubility figures for a temperature of 90° F.

Sodium Chloride	Sodium Sulphate
5·25%	26·0%
9·45%	20·3%
16·10%	13·3%
22·0 %	7·8%

At 90° F. a solution containing 22·0 per cent. sodium chloride and 7·8 per cent. of sodium sulphate is saturated with regard to both components and if allowed to evaporate at this temperature both salts crystallise out simultaneously, the composition of the "mother liquor" remaining constant. Solutions of the two salts on each side of this composition ratio will, on evaporation, deposit the one in excess until the above saturation ratio is reached.

Reducing the temperature of this "mother liquor" below 90° F. does not markedly reduce the solubility in respect to the sulphate (or chloride). Thus at 40° F. a solution saturated in respect to the chloride and sulphate still holds about 5 per cent. of the latter salt.[3]

Transition Temperatures.—At temperatures above 90° F. pure sodium sulphate solutions deposit the anhydrous salt (Thenardite) on evaporation. Below this temperature the decahydrate comes out. Sodium chloride depresses this transition temperature of the sulphate progressively, until in a solution saturated with respect to the chloride, the transition temperature has fallen to 64·2° F.

Practice at Didwana.—At Didwana the well brine is first fed into the pans about the middle of February. This brine contains on an average about 6 per cent. of sodium sulphate and about 18 per cent. of sodium chloride.[1,4] The maximum day temperature is then about 70° and the minimum night temperature 40° to 45° F. These are atmospheric temperatures and as indicated by Dr. Dunnicliff[1] it is probable that the ground and pan liquor temperatures may be as much as 15° F. higher than the minimum. On the coldest nights, however, the temperatures may fall occasionally below the transition point for the sulphate in which case some decahydrate would separate out. The amount could not be large, since the well brine only contains about 6 per cent. of sulphate and we have seen that 5 per cent remains in solution even at as low a temperature as 40° F.

Normal evaporation would, however, gradually increase the concentration of the sulphate (and chloride) until the saturation point had been reached. The brine would then contain about 22 per cent. of sodium chloride and about 8 per cent. of the sulphate. These conditions would be reached towards the end of February, by which

time the minimum night temperatures would have increased so as to reduce the possibility of decahydrate formation, especially in view of the temperature lag of the ground and the pan brine.

Let us assume, however, that the necessary low temperatures did obtain and that the maximum possible amount of decahydrate crystallised in this way from the saturated well brine prior to separation of the chloride. The amount so crystallised would be the difference between the solubilities at say 80°-90° F. and at 40° F., that is, 8 per cent. — 5 per cent. = 3 per cent. or only about 37 per cent. of the total sulphate in solution in the first batch of concentrated well brine fed to the pan to produce the first salt crop. From that time onwards the temperature would never again fall sufficiently low for the formation of the decahydrate in such a concentrated solution of the chloride.

During the season about five crops of salt are produced from successive additions of well brine. Hence the maximum amount of sulphate which could separate as decahydrate under the most favourable conditions would only be about 8 per cent. of the total sulphate content of the well brine fed to the pans during a season, which corresponds to about 2·5 per cent. by weight of the salt manufactured. The average annual production of salt over the past seventy years is about 13,000 tons and 2·5 per cent. of this is only 320 tons. At this rate of formation it would have taken about 800 years to accumulate these "Rohr" deposits.

A comparative study of the composition of the well brine and of the salt produced at Didwana also indicates that a much larger amount of sulphate has disappeared from the system than would be accounted for by an early separation as decahydrate. The analyses figures of Dr. Dunnicliff and others[1,4,6] show that the ratio of sulphate to chloride in the well brine is about one to three and only about one to eight or nine in the commercial salt (NaCl) produced. This represents a loss of more than 60 per cent. of the total sulphate fed into the pans, or about 8 times the amount which could have separated as decahydrate. Moreover, this sulphate must have crystallised *pari passu* with the salt throughout the season, otherwise the later salt crops would have been so enriched in sulphate that they would have been unsuitable for consumption. Unlike the practice at Sambhar Lake, there is no removal of concentrated "Bittern" liquor from the crystallising pans at Didwana. As a matter of fact there would be no point in doing this, since the ratio of sulphate to chloride in the original well brine is almost as high as it is in the rejected "Bitterns" of the Sambhar Lake area. When the Didwana brine reaches crystallisation point by evaporation, it is almost saturated in respect to sulphate as well as chloride and the two salts must come out together, the only further enrichment of the "mother liquor" being in regard to the small amounts of carbonate and bicarbonate present.

Crystallisation Tests.—In an endeavour to obtain a clue to the discrepancies indicated above, laboratory experiments were carried out with saturated solutions of Didwana salt and sulphate. These were allowed to crystallise by evaporation at a temperature of about 90° F. Crops of crystals were removed periodically and examined, the mother liquor being analysed after the removal of each crop. Samples of the mother liquor were also allowed to crystallise on slides under the microscope.

It was found that when the mother liquor had reached a concentration of 22 per cent. sodium chloride and 7·8 per cent. of sulphate the two salts crystallised out simultaneously during slow evaporation, the liquor remaining constant in composition. In the shallow crystallising dish used, the chloride tended to form spongy box-shaped crystals which floated on the surface and eventually collected together in the form of a scum or layer. On the other hand the sulphate invariably crystallised as small dense double ended pyramids which separated mainly on the bottom of the dish forming eventually, a crystal layer or crust. Where crystallisation was clogged and rapid (round the edges of the dish or between the floating sodium chloride crystals) contamination with sulphate crystals occurred, but with free crystallisation as in the body of the liquor, the two salts crystallised separately. This is to be expected from the different crystallisation systems to which the two salts belong, the chloride to the cubic and the sulphate to orthorhombic system.

In one experiment, after a "crop" of chloride crystals had accumulated on the surface and had been removed, leaving a thin compact layer of sulphate crystals (with some chloride) on the bottom—the mother liquor was made up to the original

volume with a solution of the same composition but diluted slightly with water. By the time the liquor had again reached saturation point the chloride had been dissolved out from the bottom layer in the dish, leaving a thin layer of pure sulphate, which increased in thickness during the formation of the next crop of chloride crystals.

When crystallisation of the *saturated* mother liquor was observed on a slide under the microscope, it was noted that sodium chloride was *invariably* the first to crystallise, leaving a small quantity of liquor temporarily supersaturated in respect to the sulphate. The sulphate eventually crystallised as separate individuals, along with the last chloride crystals.

Interpretation of Results.—Assuming that crystallisation has taken place in the salt pans on the lines indicated above, the tendency would be for the smaller and more compact sulphate crystals to find their way to the bottom of the pan below the larger spongy salt crystals. This tendecy would be accentuated by the greater density of the sulphate than the chloride crystals (2·7 against 2·2) and by the density of the solution (1·25). It would also be greatly assisted by the raking and ridging process to which the salt crystals are subjected, in the pans. This process is carried out in order to encourage the formation of larger salt crystals (NaCl) and to prevent the tendency of the salt to form an adherent cake. There is no doubt, that with this difference in density of sulphate and chloride crystals, suspended in such a dense solution, the raking would tend to cause a gravity separation, somewhat similar to the jigging process commonly used in mining to separate minerals of different specific gravity.

After removal of each crop of salt crystals from the pan, more well brine is added and for a short period the pan liquor must be unsaturated with respect to chloride and sulphate. In becoming saturated the well brine is able to dissolve three times as much chloride as sulphate, so that the tendency would be to dissolve up any sodium chloride remaining in the pan from the residue of the salt crop, leaving the sulphate crystals in the bottom of the pan in a relatively pure condition.

This explanation would account for the difference between the sulphate contents of brine fed into the pans and that in the salt crop produced, a difference in the order of 20 per cent. of the total weight of salt manufactured. Taking the average yearly production at 13,000 tons, 20 per cent. would represent an annual accumulation of 2,600 tons of sulphate, or 250,000 tons in about 100 years. This seems a more reasonable figure than 800 years.

It is worthy of note that without analytical help or guidance, the ancestors of these Didwana salt workers, or "Deswals" have evolved a simple and economical method of extracting a marketable salt (NaCl) from a brine so rich in sulphate. At the same time they have, unwittingly stored up, over several decades, rich deposits of nearly pure anhydrous sulphate, a salt for which there is now an ever-increasing demand.

Sambhar Lake.—Combined to the Didwana well brine, the brine of Sambhar Lake is relatively very much richer in chloride than sulphate (and carbonate) as the following figures show.[7]

Sodium chloride—23·1 per cent.
Sodium sulphate—2·1 per cent.
Sodium carbonate—0·45 per cent.

The practice at Sambhar is to separate as much as possible of the chloride by evaporation, until the "mother liquor" approaches saturation point in respect to the other constituents, and then to discard it as "bitterns". In this way about 75 per cent. of the salt content of the brine is removed.

Average analyses[5,7] of this "bittern" liquor show that it contains approximately:

Sodium chloride—20·0 per cent.
Sodium sulphate—8 per cent.
Sodium carbonate—4 per cent.
Sodium bicarbonate—1 per cent.

If we disregard the carbonates this composition is not very different from that of the concentrated Didwana brine, and the question naturally arises whether the Didwana method of separation might not be applied to these bitterns to produce a saleable chloride, leaving the bulk of the sulphate (or sulphate-carbonate) behind at the bottom of the pans.

Summary and Conclusions

It is not disputed that Glauber's salt can be separated from Didwana well brine on the lines indicated by Dr. Dunnicliff and Saha, or that given suitable machinery for cooling and evaporation, practically the whole of the sulphate could be recovered as decahydrate from the brine, leaving the chloride in a fairly pure condition. Separation as decahydrate, however, does not

adequately explain the origin of these "Rohr" deposits, since the formation of the hydrous sulphate is only possible during the very early days of the crystallising season. The alternative explanation here put forward is that the anhydrous sulphate has crystallised, along with the chloride, throughout the salt season and that its partial separation from the latter in the form of "Rohr" at the bottom of the pan has been brought about by several factors operating together. These include:

(*a*) The tendency of the sulphate to form relatively small dense crystals and for these to find their way to the bottom of the pan by the mechanical action of stirring or "ridging".

(*b*) The tendency of the solution to become supersaturated in respect to sulphate and for this excess sulphate to crystallise at the bottom of the pan through density diffusion and where the temperature may be lower.

(*c*) The tendency of the chloride to crystallise as spongy "boxes" which float on the surface and eventually form a crust or layer.

(*d*) The removal of the salt crop and the replenishment of the pan with unsaturated well brine which dissolves out the chloride from the bottom sulphate layer, and allows the above process to be repeated again and again.

If this view is correct, a careful study of the practice at Didwana might yield information which would be of value in enabling the controlling factors to be so adjusted as to yield a still better separation of chloride and sulphate.

1. Dunnicliff, H. B., *Curr. Sci.*, 1943, **12**, 7-12. 2. Martin, G., *Industrial and Manufacturing Chemistry*, 1917, **1**, 2, 285. 3. Robertson, J. R., *Journ. Ind. Eng. Chem.*, 1942, **34**, 133-136. 4. Auden, J. B., *Rec. Geo. Surv. Ind.* Prof. Paper No. 1, 1942, **67**, 36. 5. *Loc. cit*, p. 33. 6. *Appendix Report—Salt Survey Committee*, Gov. Ind. Press, Calcutta, 1931, p. 100. 7. Hacket, C. A., Salt in Rajputana," *Rec. Geol. Surv. Ind.*, 1880, **13**, 3, 200.

NEPHRIDIA OF EARTHWORMS

In a series of four memoirs recently published in the *Quarterly Journal of Microscopical Science* (Vols. 83 and 84), Prof. K. N. Bahl of the University of Lucknow, whose previous work on the nephridia of earthworms is so well known, has further added to our knowledge of this subject. In the first memoir he gives an account of the nephridia of the genus *Eutyphœus*, in which three kinds of minute nephridia—septal, integumentary and pharyngeal—can be distinguished. Of these the first two kinds open to the exterior, while the tufts of pharyngeal nephridia open into the lumen of the pharynx. He next describes the interesting nephridia of the genus *Hoplochœtella* which possesses large septal nephridia resembling those of *Lumbricus*, besides minute integumentary and tufted pharyngeal nephridia. The septal nephridia are remarkable in that they do not open separately to the exterior, but into a pair of longitudinal canals running along the parietes through the greater part of the body of the worm; these canals discharge their contents into the gut at its posterior end. The second memoir deals with three examples of multiple funnels. The South American giant earthworm *Thamnodrilus crassus* possesses nephridia, each of which possesses as many as *thirty four* functional funnels; the nephridium of *Hoplochœtella* has one large functional and 18 to 24 vestigial funnels; while the funnel of the nephridium of *Lampito* has two or three masses of cells, looking like embryonic funnels, on the neck of the single functional funnel. In the third memoir the nephridia of the different regions of the body of *Pontoscolex corethrurus* are described. This worm exhibits a very interesting condition of branching and division of the nephridia—in fact, the holonephridia are here "caught in the act of dividing up" into meronephridia, but the division is never complete, as even when hundreds of meronephridia are formed, as in the anteriormost pair of nephridia, they open to the exterior by a single bladder-like duct. In the fourth memoir the author describes the occurrence of the "enteronephric" type of nephridial system in *Megascolex cochinensis*, a type already discovered by him in four other genera of earthworms. The four memoirs form a very important contribution to our knowledge of the excretory system of the Oligochæta. B. P.

SIR CYRIL S. FOX, Kt., D.Sc., F.G.S., M.I.Min.E., F.R.A.S.B., F.N.I.

IT is with real pleasure that we offer our felicitations to Dr. Cyril S. Fox, Director, Geological Survey of India, on the 'Knighthood' that has been recently conferred upon him by His Majesty the King-Emperor. As an officer of the Geological Survey for more than quarter of a century, Sir Cyril Fox has made many outstanding contributions towards a fuller knowledge of the geology and mineral resources of India. There is practically no part of the country with which he is not personally familiar; nor is there any major problem in Indian geology towards the discussion of which he has not made valuable and illuminating contributions. In addition to his numerous and varied activities on the purely geological side, Sir C. S. Fox has always evinced considerable interest in the applied aspects of geology—especially in connection with Mining and Engineering; and his work in this field has secured widespread appreciation and recognition. As Director of the Geological Survey of India he has, within the last few years, reorganised the entire work of the Department, and given it a new orientation altogether, with a view to serve better the needs of the country; and this, together with the recent formation of the Utilisation Branch of the Survey, in the planning and organisation of which he has taken a leading part, will no doubt usher in a new era in the development of the mineral resources of the country, so essential for the future national progress of India.

Sir Cyril Fox has been a sincere friend and well-wisher of *Current Science* ever since its inception, and has contributed not a little towards the growth of the Journal all these years. We are particularly happy to see that his work has been so fittingly recognised by the conferring of this signal honour and we wish to take this opportunity of offering him once again our hearty congratulations, and best wishes for many more years of active and useful service in the cause of India.

DR. C. G. PANDIT, M.B.B.S., Ph.D., D.P.H., D.T.M., F.N.I., O.B.E.

"*CURRENT SCIENCE*" notes with satisfaction that the work done by Scientific Research Institutions is being increasingly recognised by the Government. We record with pleasure the conferment of O.B.E. on Dr. C. G. Pandit. This is as it should be.

Dr. C. G. Pandit is the first permanent Indian Director of the King Institute of Preventive Medicine, Guindy, one of the few recognised leading Indian Medical Research Institutions in this country. After a brilliant academic career, Dr. Pandit proceeded to England for further studies and secured the PH.D. degree of the London University for research in Bacteriology. He entered service in the Indian Research Fund Association and was posted to Madras. He was the first Professor of Bacteriology in the Madras Medical College where he was extremely popular with students. He held the much coveted Rockfeller fellowship which brought him into touch with the leading American bacteriologists. In 1934 he was selected as the Indian delegate of the Government of India to attend the session of the Congress of the Far Eastern Association of Tropical Medicine held at Nanking, China. In 1939 he received the Minto Gold Medal "for distinguished work in tropical medicine by an Indian", for the year. At the outbreak of the present world war he was specially deputed to America by the Government of India to study the problem of yellow fever, as a possible menace on account of the speeding of air transport. In 1942 he delivered the presidential address of the Medical Section of the Indian Science Congress, making his mark as the foremost worker in the profession for the year. He is aged 48 years.

Dr. Pandit has initiated and carried out outstanding researches on Vaccine, Virus, Tissue-Culture, Filariasis, and Fluorosis. A man of singular charm, affable, persuasive and polished in manners, a fluent, impressive and informed speaker, he combines in him the best of the culture of the East and the West. His many friends in India and elsewhere would rejoice at this well-deserved recognition by Government. *Current Science* offers its felicitations to Dr. Pandit and has no doubt that the Institute which he directs would take greater strides under

his able guidance and lead him to still greater distinctions.

DR. J. J. RUDRA, M.A., Ph.D., M.B.E.

We offer our warmest felicitations to Dr. J. J. Rudra on the conferment of M.B.E. in the recent Birthday Honours. After a brilliant post-graduate career first in the Indian Institute of Science, Bangalore, and later in the College of Technology, Manchester, where his work under Prof. Mileswalker brought him the Ph.D. Degree, Dr. Rudra started his career as Lecturer in Electrical Technology, Indian Institute of Science, in 1931. The investigations of Dr. Rudra on different types of alternating current motors have made him an authority on this branch of Electrical Engineering. In 1935 Dr. Rudra went over to Madras to occupy the chair of Electrical Engineering at the College of Engineering, Guindy, and now he is Principal of the above College.

Dr. Rudra has always taken a keen interest in *Current Science*. Our cordial greetings to him and best wishes for a happy and successful career.

DIWAN BAHADUR DR. K. R. RAMANATHAN, M.A., D.Sc.

Readers of *Current Science* will receive with great satisfaction the happy news that Dr. K. R. Ramanathan, Superintending Meteorologist in charge of the Poona Observatory, has been honoured by the distinction of Diwan Bahadur in the latest King's Birthday Honours List. He started his career as Demonstrator in Science College, Trivandrum, and was placed in charge of the local Observatory. In 1921 he joined the Indian Association for the Cultivation of Science to work under Professor C. V. Raman. In 1922 he was appointed Lecturer in Physics in the Rangoon University, where he remained till 1925. Both during his stay at Calcutta and at Rangoon he published series of important memoirs on the molecular scattering of light, both independently and in association with Prof. Raman. He was awarded the D.Sc. Degree of the Madras University in 1923. In 1925 he entered the Indian Meteorological Service. In his long association with this Department for the past twenty years during which he has served at various centres, he has published several papers, especially on the physics of the upper atmosphere and allied topics. Dr. Ramanathan was selected for one of the three recently created posts as Superintending Meteorologist. He has contributed considerably to the organisation and progress of Meteorological Research in India. With the outbreak of war a heavy responsibility fell on the Meteorological Department of supplying trained technical personnel required for the rapidly expanding Indian Air Force. Dr. Ramanathan has been able to attract to the Department some of the best physicists from the various centres of research in India. Dr. Ramanathan has been a well-wisher for and has enthusiastically co-operated with this Journal from its inception. We offer him our sincere felicitations on the distinction.

DISCOVERIES BY ACCIDENT

It is instructive, said Sir Oliver Lodge, to realise the state of mind which misses a discovery as well as, what is more commonly attended to, the more admirable state of mind which succeeds. Many experimenters had opportunities as good as Röntgen's to observe the X-rays which were generated in their laboratories. Sir Oliver Lodge cited the case of Rev. Frederick Smith who, on finding that the plates wrapped in a box near a tube were fogged was—so to speak—annoyed at this disturbance of his experiments, and kept the plates out of the way.

J. C. Chaston (*Nature*, Jan. 9, 1943).

LETTERS TO THE EDITOR

THE EXTERNAL FIELD OF A RADIATING STAR IN GENERAL RELATIVITY

It is well known that the generalization of Schwarzschild's solution corresponding to the external field of a radiating star has not yet been obtained. The internal field describes a mixture of matter and radiation. In the outer field there is the expanding inner zone of pure radiation, with radius r_1 at time t_1 beyond which the empty space is described by Schwarzschild's static solution. The zone of pure radiation is given by

$$ds^2 = -\left(1-\frac{2m}{r}\right)^{-1} dr^2 - r^2 (d\theta^2 + \sin^2\theta d\phi^2) + \frac{\dot{m}^2}{f^2}\left(1-\frac{2m}{r}\right) dt^2, \quad (1)$$

$$f(m) = m'\left(1-\frac{2m}{r}\right). \quad (2)$$

[As usual an overhead dot denotes a differentiation with regard to t and an overhead dash a differentiation with regard to r. $f(m)$ is an arbitrary function of m.]

Since the lines of flow of radiation must be null geordesics the radiation tensor has to be

$$T^{\mu\nu} = \rho v^\mu v^\nu \quad (3)$$

with

$$g_{\mu\nu} v^\mu v^\nu = 0 \quad (4)$$

so that

$$(\rho v^\mu)_\mu = 0 \text{ and } (v^\mu)_\nu v^\nu = 0. \quad (5)$$

The surviving components of the tensor are given by

$$-T_1{}^1 = T_4{}^4 = \frac{m'}{4\pi r^2},\ T_1{}^4 = \frac{m'^2}{4\pi \dot{m} r^2},\ T_4{}^1 = -\frac{\dot{m}}{4\pi r^2} \quad (6)$$

For differentiation along a line of flow we have the operator

$$\frac{d}{d\tau} \equiv e^{-\lambda/2}\frac{\partial}{\partial r} + e^{-\nu/2}\frac{\partial}{\partial t}. \quad (7)$$

It is found that the field equations amount to

$$\text{(i)}\ \frac{dm}{d\tau} = 0,\ \text{(ii)}\ \frac{d}{d\tau}(r^2 e^{-\lambda} T_1{}^1) = 0,$$
$$\text{(iii)}\ \frac{d}{d\tau}(r^2 \rho) = 0,\ \text{(iv)}\ \frac{dv^1}{d\tau} = 0. \quad (8)$$

The equation that is most difficult to handle corresponds to $T_2{}^2 = 0$. But it can be shown to be equivalent to (ii). The equation of continuity then leads to (iii) and (iv) readily. Thus, along the lines of flow of radiation m, v^1 and $r^2\rho$ are all conserved. It is worthy of notice that m' is positive while $\dot{m}$ is negative. This as well as the results (6) and (8) are suggested by the Newtonian analogue.

The total energy of matter and radiation is conserved. m is the affective mass of the whole system at a point. The value of m at the boundary $r = r_1$ at $t = t_1$ is a constant, M. At time t_1, for all values of r exceeding r_1, the field is given by Schwarzschild's line-element corresponding to the value M. Also $\dot{m} = -f(\mathrm{M})$ when $r = r_1$ and $t = t_1$.

The new results are (1), (2), (6), (8). Further details and astronomical applications are considered in a paper to be published elsewhere.

My thanks are due to Prof. V. V. Narlikar under whose guidance this work was done and who showed me the result 8 (i).

Benares Hindu University,
March 22, 1943. P. C. Vaidya.

Einstein, Infeld and Hoffmann, *Annals of Mathematics*, 1938, p. 65; Narlikar, V. V., *Bombay Univ. J.*, 1939, **8**, 37.

PERMEABILITY AND HYDROLYSIS OF SODIUM SOILS*

For many purposes a correct idea of the effectiveness of leaching an alkali soil is necessary. For instance, in reclamation work leaching is often practised though we do not know how long it will take to remove the evil influences

* This work was carried out under the auspices of the Irrigation Research Section, P.W.D., U.P. Government.

of exchangeable sodium. The futility of this process has been emphasised by various workers,[1] but few have attempted to study it mathematically. The following short note is meant to indicate the changes in permeability and its relation to the content of exchangeable sodium due to leaching a soil with water.

A sodium soil in contact with water undergoes hydrolysis, sodium hydroxide and hydrogen soil being produced.

$$\mathrm{Z]\cdot Na + HOH \rightleftharpoons Z]\cdot H + NaOH} \qquad (1)$$

Under leaching conditions, the exchangeable sodium is gradually replaced from the soil complex and its place is taken more and more by exchangeable hydrogen, with a consequent increase in the permeability of the soil.

In order to see how the rate of percolation of water changes with gradual replacement of exchangeable sodium by hydrogen, pure sodium soil was prepared by leaching it first with 0·05N HCl and then with normal solution of sodium chloride. The excess reagents were removed by washing with water followed by washing with alcohol. The resulting sodium saturated soil was then treated with different amounts of dilute hydrochloric acid so as to introduce different quantities of exchangeable hydrogen in the exchange complex. The excess reagents again were removed by washing with water and finally with alcohol. These soils were analysed for the Na-content and then subjected to permeability tests. Three different soils were studied.

It is found that the permeability of hydrogen-sodium soils increases in a regular manner with the ratio of exchangeable hydrogen to base exchange capacity. If y is the rate of percolation of water in cms. per hour, H the quantity of exchangeable hydrogen in milliequivalents per 100 gms. of soil, and 'B' the base exchange capacity in m.e., then the following relation is found to hold good.

$$y = \mathrm{K}e^{n\,(\mathrm{H})/\mathrm{B}} \qquad (2)$$

K and n are constants. Table I refers to the results obtained in the case of one soil.

TABLE I

	H/B	y (observed) cms./hr.	y (calcuated) cms./hr.
1	0·90	·064	·064
2	0·81	·060	·059
3	0·75	·055	·056
4	0·60	·050	·050
5	0·48	·045	·045
6	0·25	·038	·037
7	0·09	·036	·036
8	0·04	·032	·031
9	0·00	·032	·030

The observed rates of percolation agree with the calculated ones. In the case of fully saturated sodium soils the calculated rates are a little low. This is probably due to hydrolysis which a pure sodium soil undergoes, readily in contact with water. The end value of y which is also the value for the constant K of equation (2) is obtained by extrapolation with the help of the equation. The values of the constants K and n together with other constants for three soils are given in Table II.

TABLE II

Soil No.	Clay content	B	K	n
13	21·85	10·0	·0300	0·84
12	27·44	14·8	·0095	1·22
5	27·60	20·5	·0024	2·60

The time required for a definite amount of exchangeable sodium to be released from the soil can be computed as follows.

The rate of loss of sodium from the exchange complex should depend on the quantity of exchangeable sodium and on the quantity of water, which in leaching conditions means the rate at which water percolates through the soil. The following differential equation is, therefore, necessary.

$$\frac{d\,(\mathrm{Na})}{dt} = -\mathrm{K}_1\,(\mathrm{Na})\,y \qquad (3)$$

In order to determine the integration constant K, sets of percolation tubes were fitted in which pure sodium soil was kept in contact with water for months together. The rate of percolation and the content of exchangeable sodium were found out from time to time. The difference in the sodium content per hour approximates to the expression $\frac{d\,(\mathrm{Na})}{dt}$. Knowing the sodium content and corresponding rates of percolation, constant K_1 can be evaluated. Table III gives the value of the constants in the case of two soils.

TABLE III

Soil 13

Na (m.e./100 gms.)	Leaching period in hours	$d\,(\mathrm{Na})/dt$	y	K_1
10·00	0	—	·032	—
9·93	744	$9{\cdot}4\times10^{-5}$	·032	$2{\cdot}9\times10^{-4}$
9·80	1392	$9{\cdot}3\times10^{-5}$	·032	$2{\cdot}9\times10^{-4}$
9·70	1080	$9{\cdot}2\times10^{-5}$	·033	$3{\cdot}0\times10^{-4}$

Soil 12

Na (m.e./100 gms.)	Leaching period in hours	$d\,(\mathrm{Na})/dt$	y	K_1
14·80	0	—	·009	—
14·74	1560	$3{\cdot}84\times10^{-5}$	·009	$2{\cdot}9\times10^{-4}$
14·69	1344	$3{\cdot}72\times10^{-5}$	·011	$2{\cdot}8\times10^{-4}$
14·62	1464	$4{\cdot}78\times10^{-5}$	·011	$3{\cdot}0\times10^{-4}$
14·55	1488	$4{\cdot}70\times10^{-5}$	·011	$2{\cdot}9\times10^{-4}$

The values of K_1 are practically the same in the two cases.

Substituting the value of y from (2), Equation (3) can be rewritten as:

$$\frac{d\,(\mathrm{Na})}{dt} = -\mathrm{K}_1\,(\mathrm{Na})\;\mathrm{K}e^{n\,(\mathrm{H})/\mathrm{B}} \qquad (4)$$

Since $(\mathrm{H}) = \mathrm{B} - (\mathrm{Na})$,

$$\frac{d\,(\mathrm{Na})}{dt} = -\mathrm{K}_1\,(\mathrm{Na})\;\mathrm{K}e^{n}\,e^{-n(\mathrm{NA})/\mathrm{B}} \qquad (5)$$

or

$$\frac{d\,(\mathrm{Na})}{dt} = \mathrm{K}_2\,(\mathrm{Na})\;e^{-n(\mathrm{NA})/\mathrm{B}} \qquad (6)$$

The equation (6) can now be integrated (equation 7) and the approximate time for a definite stage of hydrolysis can be calculated.

$$\mathrm{K}_2 t = \Big[\log(\mathrm{Na}) + \frac{n(\mathrm{Na})}{\mathrm{B}} + \frac{n^2(\mathrm{Na})^2}{\mathrm{B}^2 2\underline{|2}} + \frac{n^3(\mathrm{Na})^3}{\mathrm{B}^3 3\underline{|3}} + \cdots\Big]_{\mathrm{Na}_{(t)}}^{\mathrm{Na}_{(0)}} \qquad (7)$$

$\mathrm{Na}_{(0)}$ and $\mathrm{Na}_{(t)}$ represent sodium contents at the beginning and at the end of time t.

The series on the right is convergent. Making use of the first five terms only and substituting for different constants for two soils we get the following values:

	Time for 50% hydrolysis	Time for total hydrolysis
Soil 13	4·23 years	11·63 years
Soil 12	12·40 years	49·62 years

It should be noted that the rate of hydrolysis increases with the rate at which products of reaction are removed. In other words hydrolysis will be faster the greater the rate of percolation. It has also been observed that the rate of percolation is inversely proportional to the clay content and the base exchange capacity.[2] Hence the hydrolysis will be more pronounced in soils which are poor in clay content and of low exchange capacity.

Under field conditions a number of exchange reactions may take part along with those contemplated above. For instance, many alkali soils have a reserve of $\mathrm{CaCO_3}$ and the process of 'hydrolysis' is usually combined with the process of 'calcification'. The natural conditions in the field present a variety of such combinations. Further the greater compactness of the soil in the fields will tend to make the process of hydrolysis much slower than under laboratory conditions.

Chemistry Department,
Lucknow University,
April 6, 1943.

M. R. Nayar.
K. P. Shukla.

1. Leather, Report of Usar Land Reclamation in U.P., 1914. 2. Nayar and Shukla, *Proc. Indian Sc. Congress*, **42**, p. 74.

THE NATURE OF THE TEA OXIDASE SYSTEM

The cytochrome theory of tea fermentation advanced by Roberts[1,2] has not been substantiated so far by any direct evidence for the presence of cytochrome and cytochrome oxidase in tea leaf. A closer investigation of this aspect of the problem based on spectroscopic and manometric determinations has recently given results quite contrary to those of Roberts.

Cytochrome.—Spectroscopically cytochrome is easily detected in the reduced state by its characteristic absorption spectrum. In tea, by observing the cytochrome '*b*' band, Roberts claims to have demonstrated the presence of cytochrome, not in the leaf, but in the basal portions of the stem. In choosing this tissue for observation his object was probably to exclude any interference from chlorophyll. In my examination of this tissue in finely ground suspensions and with added succinate or $\mathrm{Na_2S_2O_4}$ I could obtain no indication whatever for the presence of cytochrome. Similarly when other tissues of the tea plant were separately collected and tested none of them displayed any specific cytochrome bands.

Extraction of chlorophyll and tannin from leaf by acetone would eliminate their interference with the detection of cytochrome. Thus Yakushiji[3] has reported the presence of α-bands of cytochromes *b* and *c* in acetone-extracted spinach leaves. No cytochrome could, however, be detected in the acetone-extracted tea leaves and attempts to prepare cytochrome C from such material by the method of Keilin and Hartree[4] yielded only negative results.

There was again no spectroscopic evidence for the presence of cytochrome in highly active and concentrated solutions of tea enzyme in which cytochrome must be expected if the observed activity were due to the cytochrome system. Selective absorption was absent both in the ultraviolet and the visible regions of the spectrum.

Cytochrome Oxidase.—Preparations of cytochrome oxidase from goat heart muscle readily oxidised cytochrome C, such oxidation being denoted by the disappearance of the reduced cytochrome C spectrum. But a tea oxidase preparation which was highly active on catechol ($-\mathrm{Qo_2} = 170$) failed to oxidise cytochrome, reduced by Pd and $\mathrm{H_2}$, and its spectral characteristics persisted for a considerable period in presence of the enzyme. In the preparation of this enzyme our earlier method was further refined so as to minimise the inactivating effect of acetone on cytochrome oxidase, the acetone extraction being carried out rapidly at $-20°$ C. The leaf powder was then extracted with buffer at pH 7·0 and purified by fractional saturation with $\mathrm{(NH_4)_2SO_4}$ and dialysis. A suspension of the insoluble leaf residue gave results similar to those of soluble enzyme and it is clear that cytochrome oxidase is completely absent in both.

Corroborative evidence against the cytochrome theory was further obtained by $\mathrm{O_2}$ uptake measurements as given below.

Oxygen Uptake of Various Reaction Systems

Reaction	μl. O_2/hr.
1. Catechol + Tea oxidase	198
2. Reduced cytochrome C + Tea oxidase	0
3. " " + Succinate + Tea oxidase	3
4. " " + Succinate + Heart muscle oxidase	46
5. " " + Succinate + A succinic dehydrogenase preparation	9
6. Reaction 5 + Tea oxidase	11

The succinic dehydrogenase preparation used in the last two reactions had comparatively only a slight cytochrome oxidase activity. If tea enzyme had consisted of cytochrome oxidase it should have induced a greater O_2 uptake in reactions 2, 3 and 6 due to an increase in cytochrome oxidase concentration.

These results demonstrate unequivocally that tea oxidase cannot be identified with cytochrome oxidase. It appears, therefore, that without any positive evidence for the presence in the leaf of the components of the system Robert's cytochrome theory of tea fermentation cannot be considered as valid. On the other hand our previous finding[5] that tea oxidase is a polyphenol oxidase with an established specificity for O-dihydric phenols provides a simpler and a more satisfactory explanation of the tea fermentation process.

Details will be published elsewhere.

My grateful thanks are due to Sir J. C. Ghosh, Director, Indian Institute of Science, Bangalore, for the hospitality of the Institute laboratories and to Mr. M. Sreenivasaya for much advice and help in the course of this investigation.

Section of Fermentation Technology,
General Chemistry Dept.,
Indian Institute of Science,
and H. B. Sreerangachar.
Tea Research Institute of Ceylon,
Talawakelle, Ceylon,
May 5, 1943.

1. Roberts, E. A. H., *Biochem. J.*, 1940, **34**, 500. 2. —, *Ibid.*, 1941, **35**, 1209. 3. Yakushiji, E., *Acta phytochimica*, 1935, **8**, 325. 4. Keilin, D., and Hatree, E. F., *Proc. Roy. Soc.*, 1937, **B 122**, 298. 5. Lamb, J. and Sreerangachar, H. B., *Biochem. J.*, 1940, **34**, 1472.

CATALYSIS OF DICHROMATE-HYDROBROMIC ACID REACTION BY THE OXALATE ION

In a previous publication[1] we have reported the marked catalytic effect that oxalate ion exerts on the reaction between dichromate and hydriodic acid. We have now found that the oxalate ion also catalyses the reaction between dichromate and hydrobromic acid. Under the conditions of our experiments and at the hydrogen-ion concentration employed, the velocity of the reaction between dichromate and hydrobromic acid is extremely slow, but in the presence of a small concentration of oxalate the speed of reaction becomes appreciable.

The reaction was followed by the estimation of the bromine liberated iodimetrically, after extraction with carbon tetrachloride. The concentration of oxalate used was between ·025N to ·075N; in this range of concentration the rate of reaction was from 20 to 45 times more than the rate of reaction in the absence of the oxalate ion.

The catalytic effect of the oxalate ion is so pronounced that we can set up a lecture demonstration experiment using this reaction.

The quantitative aspect of the reaction is under investigation.

Andhra University and
Andhra Christian College,
Guntur, C. R. Viswanatham.
April 30, 1943. G. Gopala Rao.

1. Viswanatham, C. R., and Gopala Rao, G., *Curr. Sci.*, 1942, **11**, 102.

DESCRIPTION OF AN EGG-LAYING FEMALE OF THE INDIAN GLOW-WORM, *LAMPROPHORUS TENEBROSUS* WALKER

Paiva, C. A. (1919) has given for the first time a very short description of the adult female Indian Glow-worm. Hutson, J. C., and Austin, G. D. (1924) in their bulletin on the Indian Glow-worm deal mostly with the breeding habits of the female. A detailed study of the structure of the adult female has not been made till now.

The females appear to be very rare and seasonal in occurrence. Till now only six specimens have been collected by me from inside Tambaram bushes at night just after heavy rains and one was actually reared out of a larva inside the laboratory. They vary from 55 mm. to 70 mm. in length and most of them have been observed to become dark and assume piceous margins round the terga soon after death.

The following description of the structure of the egg-laying female *Lamprophorus tenebrosus* Wlk. is based on a single specimen collected on 2nd December 1942, from the College premises, Tambaram, Chingleput District. My thanks are due to Prof. C. Lakshminarayanan, under whose supervision and guidance this study was made.

Length—70 mm.; Breadth—17 mm.

The whole body is pale ochreous with the lateral tergal areas clear and more or less diaphanous. The inner luminous mass of ovary is clearly visible at night through the thin dorsal plates. The head is highly retractile into the thorax and the extensive cervical integument presents during retraction a double folding which is rarely straightened out completely. The adipose tissue is concentrated at special regions of the body. Dorsally it occurs as milky white patches on either side of the terga, but somewhat diffused ventrally. It is also discernible through the translucent pleurites. The female exoskeleton is delicate and least chitinised. Certain articular sclerites in the basal region of the thoracic legs which are strongly chitinised and differentiated in the larva are ill-defined and imperfectly chitinised in the female. The adult female is apterous and larviform and appears to be degenerate. Although the plates are thin and clear with least pigmentation and the body plumpy and delicate, the tarsi and antennæ present adult coleopteran structure. The abdomen has become loose and plumpy to accommodate the large mass of ovary inside. The female moves about actively at night producing a most brilliant greenish white light outrivalling the larva or her own mate. At night she is frequently noticed to assume a peculiar pose with her abdomen curled up and the photogenic organs exhibited to the best advantage to the flying males.

Head (length—6 mm.; breadth—5 mm.).—Head is prognathous, dorso-ventrally flattened, glabrous and slightly darker than the rest of the body. Head-capsule is foveate and flat with a wide mid-ventral gap accommodating the labio-maxillary plate. Posteriorly the head-capsule is connected on the ventral side by a chitinous bar, the gular bridge. The median ill-defined epicranial suture divides the head-capsule into a median dark frontal and lateral parietals. The frontal is deeply notched anteriorly by the V-shaped fronto-clypeal suture, beyond which lies the triangular and centrally infuscate clypeus. The parietals extend anteriorly up to the base of the antenna and are separated from the ventro-lateral genæ by a longitudinal suture. A fuscous black eye-spot occurs at the anterior margin of each parietal. Antennæ are six-jointed and take their origin from the head-capsule in between the lateral margin of the clypeus and the front margin of the parietals. Each antenna is placed over a short, stout, whitish basal piece which Paiva (1919) describes as the basal antennal joint. This is not a true joint but only the membranous antacoria into which is the antenna often telescoped. The true basal antennal point (the second joint of Paiva) is as long as or slightly longer than all the remaining joints put together. It is little chitinised but bears anteriorly a few rufous hairs. Beyond this there are five small distinct, strongly chitinised joints, each with a few delicate hairs. The distal joint is rounded and unimucronate and carries two conspicuous rufous hairs. Paiva appears to have missed one of these joints and so he also describes the antenna as six-jointed. Mandibles are dark reddish brown, falcate, and without the mandibular canal so characteristic of the larva. The mandibles articulate with the head-capsule both dorsally and ventrally by strong condylar articulations. The mandibular postartis is rounded and articulates with the acetabulum in the genal postcoila. The hypopharynx, mandibular appendages and other tufts of stiff hairs of the larvæ appear to be very much reduced. The labio-maxillary plate consists of the narrow median labium and the stout lateral maxillæ. The base of the maxilla is formed of the small cardo and the large stipes which is very slightly and irregularly chitinised and carries a strong ventral spine. The maxillary palp is stout, strongly setose and four-jointed, of which the penultimate joint is very narrow and the distal one globular with a bright oval sensory streak. The galeæ are two-jointed with the distal joint carrying a few tactile hairs and the basal joint with a row of about five stiff hairs. Internally the galeæ form two sharp cutting edges. The labium is divided into a prelabium and a postlabium by the labial suture. The postlabium includes the mental and the submental regions. The postlabium in the larva is strengthened by a single postlabial sclerite which represents both the mentum and the submentum. In the female the submentum is not chitinised but the mentum is strongly chitinised into a long cylindrical posteriorly narrowed sclerite. The prelabial sclerite is strong. The labial palp is two-jointed, the basal joint being stouter than the distal. The prelabium bears dorsally a median cutting edge which works along with those of the maxillary galeæ.

Thorax.—The terga are feebly channelled by a mid-dorsal sulcus. The pronotum is beautifully arched in front and broadened posteriorly with a slight elevated disc in the middle and ventro-laterally depressed lateral areas. The meso and metanotum are not arched but are sub-rectangular with lateral margins rounded.

Pronotum—*l.* 10 mm.; *b.* 14 mm. Mesonotum—*l.* 8 mm.; *b.* 18 mm. Metanotum—*l.* 8 mm.; *b.* 20 mm.

The marginal ridge of the terga is strongly developed round the anterior border of the the pronotum. Ventrally the sclerites are ill-defined. Thoracic legs have well-developed tarsi. All the legs are more or less similar. Coxa stout. Coxo-trochanteral articulation dicondylic. Postcondylar trochanteral area rounded. Trochanter long and narrowed distally with a distinct transverse suture dividing it into two sub-joints, the proximal joint carrying the condyles for coxal articulation and the distal immovably fixed with the femur.

Femur stout and broad distally with two prominent rows of hairs. Tibia cylindrical and narrow. Femoro-tibial articulation dicondylic. Tarsus four-jointed, basal three joints piceous and small and distal joint very long and stout with two strong claws.

Abdomen.—Abdomen consists of nine distinct segments. The abdominal terga form a row of imbricate plates. All the plates except the ninth are channelled by a mid-dorsal sulcus. The posterior plates have their postero-lateral areas more rounded. Ventrally the sternal plates are roughly rectangular and each is provided with four longitudinal ridges each carrying a row of soft spines. The pleurites are squarish plates carrying the spiracles. The pleurites of the penultimate segment are 'eburated' (Gorham, H. S., 1880) and form the photogenic area. The last abdominal segment carries the anal brush.

Internal Anatomy.—Immediately beneath the tergal plates is an extensive sheet of adipose tissue, below which is the massive ovary extending into the thorax and even into the cervix. The alimentary canal lies considerably flattened under the ovary. The long narrow œsophagus runs from the pharynx to a small sac-like pouch which leads into an elongated depressed and almost empty mid-intestine, whose walls carry longitudinal folds. The mid-intestine is followed by the coiled intestine. Four Malpighian tubules occur. Below the alimentary canal is the long chain of ganglionated double ventral nerve cord. The thoracic and abdominal ganglia are similar in size. The pro-, meso- and metathoracic ganglia supply the three pairs of legs. The metathoracic and first abdominal ganglia are close to each other. First five abdominal ganglia are very distinct, placed uniformly apart and supply the spiracles. The remaining abdominal ganglia are crowded and very close to each other. Below the nerve cord is another layer of fat.

Dept. of Zoology,
Madras Christian College,
Tambaram, J. SAMUEL RAJ.
May 10, 1943.

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FLUCTUATION IN THE WEIGHT OF A PLANT

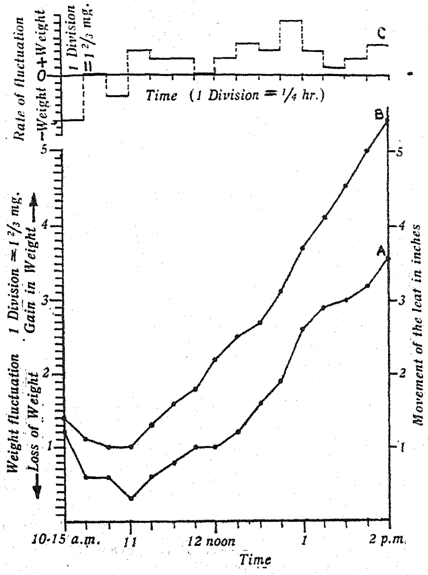
ALTHOUGH extensive work has been done by Miller (1925) and others[1] on the increase in the weight of a plant at intervals of a week or more, still no reference is noticed on the fluctuations in weight at short intervals. In his papers on leaf movements the author[2,3] has mentioned that this movement is brought about by the variation in the turgidity of the plant body, indicating a fluctuation in the water content of the plant. Further work done in this line denoted a relationship between the direction of leaf movement and the fluctuation in the weight of a plant, whether the plants were exposed to natural light or artificial light. The author's observations on *Lycopersicum esculentum* are mentioned in the following note.

The potted plants, about twenty days old, were selected for observation. Since the leaf movement and weight fluctuation could not be studied from the same plant at the same time the two aspects had to be studied from different plants exposed to similar external conditions. The plant for the study of weight was removed from the pot, and its root system was carefully washed before the plant was weighed. The weight of the plant was 1·253 gm. The solution for the plant was prepared from the manured soil in which the plant was growing, and was thoroughly aerated. The plant was suspended from the beam of a balance but enabled the root system to be within the soil solution in a trough free from the balance. This enabled the free movement of the beam and the connected lever. By a suitable arrangement the level of the solution was maintained constant. Actual recording was started about an hour or more after setting up the experiment. The recording was done between 10-15 a.m. and 3 p.m. (new time), with the plants exposed to the sky light from the northern window, but not to direct sun. The room temperature, which was 77° F. when the experiment was started, showed a rise of 2° F. in the course of six hours, the first perceptible rise being after 12 noon. Readings were taken at intervals of 15 minutes with the help of levers magnifying 15 times. The three graphs A, B and C are drawn to a magnification of 75.

The weight curve (A) shows that the plant was losing weight till about 11 a.m., and that after this there was a continuous increase in weight. The graph for the leaf movement (B) indicates that the leaf also changes its direction of movement about the same time, the upward and downward movement of the leaf thus coinciding with the oscillation in the weight of a plant. Graph C explains the rate of change in the weight of a plant.

The above observations prove that although the plant shows an increase in weight from day to day, still it will be losing weight during certain hours of the day. The movement of the leaf directly signifying a variation in the turgidity of the plant-body at regular intervals, may also be taken to be an indirect expression of the fluctuating weight of the plant

mostly due to the variation in water content. In conclusion it may be stated that this highly



Graphs to explain weight fluctuation in a plant.
(*Lycopersicum esculentum*)

A. Graph to show variation in weight. × 75
B. ,, ,, ,, leaf movement × 75
C. ,, ,, ,, rate of variation in weight × 75

interesting feature happens to be a normal occurrence in the daily life of this plant.

A paper dealing with this aspect in several plants will be published later.

Department of Botany,
Intermediate College,
Mysore, C. V. KRISHNA IYENGAR.
May 12, 1943.

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THE BLOOD GROUPS OF THE DOMS

DR. D. N. MAJUMDAR (*Man in India*, Dec. 1942) has again raised the question of illegitimacy among the Doms (*Current Science*, April 1942) as found by him through blood groups, without adducing any new relevant data whatsoever. Since it is known that theoretically exceptions to the laws of Bernstein might result from mutations and the chromosomal aberration, known as non-disjunction, it is desirable that the detailed data be published, so that no room is left for any of the above causes. Attention may here be drawn to the exceptions of Bernstein's laws found by other workers (Wiener, 1935) and it would be worthwhile to examine Dr. Majumdar's results in the light of these known exceptions.

Bose Institute,
Calcutta,
March 9, 1943. S. S. SARKAR.

Wiener, A. S., *Blood Groups and Blood Transfusion*, 1935.

THE paper under reference (*Man in India*, December 1942) is a detailed account of the Doms and their Blood Groups which was briefly inserted in *Current Science*, April 1942.

I did not raise any question of illegitimacy among the Doms' but merely stated facts. The cases that could be detected were not more numerous than could be explained by illegitimacy. The people who were examined and whose bloods were of doubtful affiliation in the majority of the cases, themselves affirmed my suspicions.

Every serologist working in Blood Groups, is expected to know the theoretical limitations of Bernstein's laws but where such obvious evidence exists, I think, there is no necessity of assuming chromosomal aberration or mutation. Snyder has pooled (1929) the extant data on the subject collected by a large number of different investigators. Out of 1,600 offsprings in 571 unions between individuals belonging both to Group I in Jansky's classification, 27 were found to belong to one of the remaining groups. This was not considered by Lancelot Hogben as due to chromosomal aberration or mutation but he traced these to illegitimacy and occasional failure of test. (*cf.* Lancelot Hoben, *Genetic Principles in Medicine and Social Science*, pp. 68-90.)

The relevant data can only be published on two conditions being fulfilled, *viz.*, (1) space made available in some scientific journal, (2) immunity against legal proceedings being guaranteed. As both the conditions are difficult to satisfy immediately, I am afraid Mr. Sarkar will wait. Mr. Sarkar knows that the entire blood group data (about 5,000 samples already tested) collected in connection with the anthropometric survey of the U.P. will very soon be published in the Report under preparation and if he can wait, *he would be able to pronounce his verdict on the 'relevant data'.*

Anthropological Laboratory,
Lucknow University,
March 22, 1943. D. N. MAJUMDAR.

REVIEWS

Mass Spectra and Isotopes. By F. W. Aston. (Edward Arnold and Co., London), 1942. Pp. xii + 276. Price 22-6-0.

This is a very readable book written with authority by one who is master of the field. It is not a treatise on the subject in which every development is dealt with in equal detail, but is written, rather, from a more personal angle, and since the personality of the author has occupied a central position in the field from the beginning, a very balanced account of the whole development of the subject from its inception to its present more or less completed stage has resulted. The book is in four parts, and is illustrated with twelve well-chosen plates.

The first part traces the history of the subject, which really entered its modern stage when the idea of isotopes was put forward by Soddy in 1910, up to about 1925. There is a chapter devoted to a description of the details of Aston's first mass spectrograph and an elementary account of the theory underlying it. I feel, however, that the full mathematical theory of the spectrograph as worked out by Aston and Fowler should have been given in the book for the benefit of those who wish to understand the working of the instrument in greater detail, and this might well have been done in an appendix in order not to encumber the text. Similarly, the questions of dispersion and resolving power might also have been treated at greater length.

The second part of the book deals with the modern technique of mass spectrography and the development of high precision instruments. It is a very well written survey of the field which enables the reader to appreciate the triumph of modern technique in the enormous increase in the precision of the modern instruments over the original mass spectrograph.

The third part of the book is a most useful and authoritative compilation and deals with each element in the order of its atomic number. For each element all the known stable isotopes, and of the naturally radio-active substances, those stable enough for mass spectrum analysis, are mentioned, and the best figures for their relative abundance and packing fractions, when known, are given. In the words of the author, "This account constitutes a summary with references, of all the data upon which have been based the first International Table of Stable Isotopes in 1936 and each of its annual publications since". It forms a most useful place of reference for the research worker in the field, whether experimental or theoretical.

The fourth part of the book deals with several distinct themes. There is an elementary chapter on modern ideas about the structure of nuclei. In this connection I doubt the wisdom of publishing a diagram like Fig. 37, which might give to the beginner a completely outmoded picture of the atom, when with the help of the ideas of state, energy and angular momentum an accurate knowledge of the atom could have been conveyed with equal simplicity and at hardly greater length. There is a very good chapter on the isotopic effect in molecular spectra, and one on the isotopic effect in atomic spectra and the allied properties of nuclear spin. Finally there is a good chapter on the separation of isotopes. I think that the separation of isotopes by electrolysis is of sufficient importance to have merited a more detailed description of its technique, since it is the application of this method to the isotopes of hydrogen which has led to the only complete separation of a rarer isotope on a large scale that is so far known.

The author is to be congratulated on having treated a bulky subject in such a clear and simple way and yet with completeness in its main essentials. The above remarks have been made merely as suggestions, which might be considered when a new edition is contemplated, in order to increase the completeness and usefulness of what is really an *excellent* little book. The book is to be warmly recommended not only to the student, but also to the theoretical physicist who wishes to get a knowledge of the methods and experimental results from which the facts upon which he builds his theories are derived.

H. J. BHABHA.

Polarography. By I. M. Kolthoff and J. J. Lingane. (Interscience Publishers, Inc., New York, N.Y.), 1941. Pp. xvi + 510, with 141 illustrations. Price $6.00.

The book is intended "to present a complete and critical account of the present status of polarographic analysis ... and the newly developed 'amperometric titration' methods". The book is divided into eight parts and thirty-three chapters. The captions of these eight parts indicate the subject-matter of the book and are: Introduction; Theoretical Principles; Apparatus and General Technique; Inorganic Polarographic Analysis; Organic Polarographic Analysis; Biological Applications of Polarography; Voltammetry with Platinum Micro-electrodes; Amperometric Titrations.

The theoretical principles underlying these methods of analysis have been treated in some detail and the experimental evidence on which they are based have been amply cited. The recent work of the senior author and his collaborators have been drawn upon extensively. The book gives a full account of the present position of our knowledge regarding polarographic analysis. It will be found very useful by those interested in this branch of electro-chemical analysis and more particularly by research workers in this subject. Its very wealth of detail, however, may cause embarrassment to those who are concerned more with the use of the method than with the details of numerous investigations some of which have

not passed beyond the formative stage of development. It would be of great advantage if the subjects were presented in the next edition in two parts, one giving a brief outline of the theoretical principles, just sufficient experimental details for accurate results and only those examples of analyses where these methods have been found to be reliable and most useful. Detailed theoretical treatment and the various applications where the method does not yield results which are quite unequivocal might be dealt with in the other part. The theoretical background of the whole subject though it has been considerably cleared up by recent work seems to admit of considerable improvement in many places. One such topic is the interpretation of maxima. The fundamental relations in section 6 of the second chapter would, it is hoped, in due course be capable of a more direct theoretical treatment. One would have liked a more comprehensive discussion of the investigations on the electrocapillary curve which, as the authors have indicated, is of utmost significance in polarographic work.

Taking all in all, however, the book is a welcome publication and illustrates the great progress made in the development of these methods and their utility in which the authors and their collaborators have actively participated. In addition to the subject and author indices there is an appendix containing half-wave potentials of inorganic substances which will be found to be very useful.

The reviewer regrets the delay in reviewing the book partly due to pressure of work and partly for other reasons. J. N. M.

Electrical Engineering Practice, Vol. II. By J. W. Meares and R. E. Neale. (Chapman & Hall Ltd., London), 1942. Pp. xii + 663, Figs. 244. Price 35*sh*.

This is volume number two of the well-known work of the authors which is now running in its fifth edition and which is published in three volumes. The first volume was published a year earlier.

Volume two, as it appears in its present form, is an improved and enlarged edition of the previous one. The contents and the index are so arranged that they form one single unit for the three volumes together. Further, reference is to numbered paragraphs and not to pages. There are in all 1060 paragraphs of which the first 386 are in volume I and 669-1060 in volume III and the rest in the volume under review. The subject-matter included, therefore, is divided into three parts called parts IV, V and VI and it runs through eleven chapters in all, beginning with chapter 17 and ending with chapter 27. Part IV deals with transformation, conversion and storage of electrical energy; part V deals with distribution and control in branch circuits; and finally, in part VI are given the applications of electrical energy.

The book is packed with useful and valuable information. It has been brought up-to-date and one distinctive feature about it is that although it deals essentially with modern practice still it gives wherever necessary information about the older practices on which later practices are based. This is a book which will be found of great help to every engineer—whether electrical, mechanical or civil. It has all the advantages of a hand-book without its disadvantages. The field covered is very large and yet it is written in such a way that whatever the topic that is being discussed, the reader gets the impression that he has been given a good bit of information which he can understand and which will be of definite use to him. The balance that has been achieved between what one calls 'theoretical' and what one calls 'practical', makes the book unique.

There are plenty of illustrations included in the text as also a large number of tables which give information not easily accessible. At the end of each chapter a more or less exhaustive bibliography is given which makes the book still more valuable.

In conclusion, in the opinion of the reviewer, this book is meant for an engineer whose duties demand from him both technical knowledge and experience. Money spent in buying these volumes is money well invested.

Prakashlekhan Shastratil Ascharye. By K. A. Damle, B.SC. (Published by the author at Damelewada, Shastripol, Baroda), 1943. Pp. 156, Figs. 39. Price Rs. 2.

This little volume of 156 pages written in Marathi, is not exactly a treatise on photography and allied subjects although it contains a lot of information. It is essentially meant for the general reader. It is written in an easy style and succeeds in keeping the interest of the reader throughout.

The book can roughly be divided into two parts. The first part which covers four chapters unfolds the remarkable story of the birth and growth of the science of photography. The rest of the book is devoted to a number of topics connected with photography the range of which is suprisingly wide. Here are some of the items dealt with: Cinematograph, talking pictures, trick photography, colour photography, X-ray, infra-red, ultra-violet photography, spectro- and micro-photography, photostat, etc. The reader will find something interesting to read about almost every one of these.

The author has done a distinct service to the Marathi reading public in writing this interesting and instructive book.

A Text-Book of Intermediate Physics in Tamil, Vol. II. By R. K. Viswanathan and V. N. Ramaswamy. (Annamalai University, Annamalainagar), 1941. Pp. lxxi + 689-1372 +xii.

This is a successful first attempt at writing the more advanced general science in Tamil. The book is written in free Tamil and the presentation of the subjects, light, sound, magnetism and electricity, follows the routine text-book type. The scientific equivalents coined

are mostly simple and intelligible. However, it would be proper to select a few of these which, in the reviewer's opinion, are not satisfactory. Projecting lens is '[illegible]', while projection is '[illegible]' and also '[illegible]' is 'amplitude'. Barium is '[illegible]' on page 1312 and '[illegible]' on page 1330. The reviewer does not also feel happy about the use of both Tamil and English letters in the same figure or equation. There are a number of typographical errors and indiscriminate uses of bold printing, though these do not seriously mar the usefulness of the book. It is to be regretted that a text-book on Physics for Intermediate should be so badly illustrated. An English to Tamil glossary would add to the value of the book.

V. S. G.

Marriage and Family in Mysore. By M. N. Srinivas. (New Book Co., Bombay), 1942. Pp. 218. Price Rs. 7-8-0.

There was a time when, for anthropological information concerning India, the student of the subject had to depend entirely on workers in European Universities and foreign periodicals such as *Anthropos* and *Man*, but since Risley started the ethnographic survey of India, the position with regard to field data steadily improved, though their interpretation and analysis lagged behind. To draw conclusions and arrive at generalisations from a mass of ethnographic material is not an easy task, but to be useful it has to be accomplished in the light of general anthropological theory. Scientific anthropology begins only when regional data can be fitted into those for the whole world. For the anthropology of Mysore, the book under review marks the beginning of the interpretational phase. The Bombay University and Prof. G. S. Ghurye have to be thanked for helping the production of this book; while South Indian Universities are treating Anthropology in a step-motherly fashion, the Bombay University seems to show a better appreciation of its value as a scientific discipline. As the Vice-Chancellor of the Mysore University remarks in his Foreword, "Works on Indian Sociology based on careful field study are not very common yet". Man, before he can plan the future or order the present, should know himself. There may be some who might be inclined to regard the theme of this book as banal. The reviewer would ask any Mysorean who holds such a view this simple question: "How many of you who have worn the *Bhashinga* or sat behind the 'milk-post', or tied a *tali* know their full meaning? If you do not know it, look for it in the pages of Mr. Srinivas's book." In nineteen brief chapters, he discusses the institution of marriage in Mysore as it affects its various tribes and castes, and in all the chapters there is something that will interest every class of readers.

For his material, the author depends chiefly on *Mysore Tribes and Castes* and *Mysore Gazetteer*, but whereas these pioneer works are on the observational level, Mr. Srinivas deals with the rites, practices and the various sociological situations at a deeper level. Occasionally he disagrees with the meanings given to some rituals by the earlier writers, and most often he is right. This means no disparagement to the senior workers, for anthropology has outgrown such theories as universal matriarchate, primitive communism, promiscuity, etc. Quite correctly Mr. Srinivas has tried to evaluate the information at his disposal and pointed out where it is incomplete or defective.

Hindu Culture in Mysore is divided into a top-grade—Sanskritic as Mr. Srinivas styles it; a middle grade of mixed composition to the Sanskritic veneer of which constant addition takes place due to the uncritical borrowing by non-Brahman castes of Brahman practices; and low grade, the carriers of which are the primitive tribes. The otherwise static institution of marriage is complicated in the middle grade by the imitativeness of non-Brahman communities and the changes are always fatal in their effect on the position of women. Mr. Srinivas issues a warning against this, but social changes would still go on unregulated unless the people themselves realise that the consequences of these unconscious innovations are deleterious.

The subject matter of the book is difficult to summarise and the reviewer can only recommend it to those interested in Sociology in general, and to Mysoreans in particular.

A. A.

School and College Libraries. By S. R. Ranganathan. The Madras Library Association), 1942. Publication Series No. 11. Printed by Thomson and Co., Ltd., Madras. Pp. 432.

As Mr. John Sargent says in his Foreword to the book, Mr. S. R. Ranganathan needs no introduction to the reading public of India. The present one is, in fact, the tenth of his books on Library Technique. The book is the product of the realisation by the author of the potency of a well-equipped library in stimulating the self-educability of students of the various school and college standards.

The book consists of six parts and twenty-seven chapters; it commences with the chapter on "Why" of school libraries and proves the important place that the school library should occupy in the education of the individual as this alone leads to life-long self-education. In the chapters that follow are given useful information as to what an Elementary School and a High School library should be, how books should be arranged in the libraries, what books there should be, how they should be classified and so forth. Details regarding book selection, accessioning and numbering work are also given. There is also a useful index at the end of the book.

Libraries hold an honoured place in the cultural economy of the great nations of the world. In fact, the libraries should be regarded as people's universities. It is a fact that in India libraries have not yet gained the importance they deserve to have. Mr. Ranganathan's books are sure to stimulate opinion in favour of a strong library movement and help to organise library work on scientific lines.

B. V. SASTRY.

CENTENARIES

Gill, David (1843–1914)

SIR DAVID GILL, a British astronomer, was born in Aberdeen, 12th June 1843. His inspiration to scientific studies, he owed to Clerk Maxwell while at the University of his place. He took charge of his father's business which was watch-making; but he devoted his spare time to the pursuit of science.

In 1863 his desire to provide his town with time service similar to the one at Edinburgh, led him to re-establish a disused observatory at the University and he fitted up the necessary instruments and established electric control of the important clocks of the town. This venture led him more into astronomy and with instruments made by his own hand, he soon began observations of double stars.

In 1870 he took charge of the private observatory started by Lord Lindsay. Besides fitting up, he went to Mauritius with about fifty chronometers to observe the transit of Venus in 1874. His work there is said to have inaugurated a successful method to find the sun's distance.

In 1877 he set up an observatory at the island of Ascension to measure the distance of Mars when it came exceptionally near the earth. His tenacity is shown by his managing to shift the observatory to a new place in five days' time to avoid cloud banks that obstructed. The sun's distance was again determined with a greater accuracy.

In 1897, Gill was appointed astronomer at the Cape of Good Hope. The Observatory had then only one instrument. But when he left in 1907, he left it fully equipped with modern instruments and a fully qualified staff to carry out work of the highest order. During his period of office, he measured the distances of twenty-two stars and made an era in the measurement of stellar distances. In 1889 he re-determined the sun's distance correct to one point in a thousand. Gill was also a pioneer in the application of photography to astronomy. In 1885 he began a photographic survey of the southern sky. The results published in the *Annals* of the Cape Observatory show the positions and magnitudes of about 400,000 stars. This great survey formed the basis of important investigations in the distribution of stars. Gill took part also in the triangulation of a large part of Africa.

After his retirement, Gill wrote his *History and Description of the Royal Observatory, Cape of Good Hope*, and it was published in 1913.

Gill was knighted in 1900 and was President of the Royal Astronomical Society and of the British Association for the Advancement of Science.

Gill died of pneumonia in London, 24th January 1914.

University Library,
Madras,
June 4, 1943.

S. R. RANGANATHAN.

SCIENCE NOTES AND NEWS

Conversion of Town Wastes into Agricultural Manure.—The Government of India have recently sanctioned a grant of Rs. 1,86,000 to the Imperial Council of Agricultural Research for introducing into municipal areas an improved method of converting town wastes into good quality agricultural manure by the process of composting. A large amount of work on composting has been carried out both in this country and elsewhere; particular attention should, however, be invited to the pioneering researches of Fowler, Howard and their associates as also to the work of the various agricultural departments in the country. Investigations had been going on at the Indian Institute of Science, Bangalore, on the above subject for a number of years, under the auspices of the Imperial Council of Agricultural Research, which showed that the methods till now recommended for the composting of town wastes were defective in that (*a*) most of the methods involved frequent turning-over of the mass, which promoted excessive aeration and rapid loss of moisture, and also resulted in increased smell and fly-nuisance; and (*b*) such turnings and aerobic conditions resulted also in heavy losses of valuable manurial constituents such as nitrogen and organic matter, to the extent of even more than half of the quantities originally present; and (*c*) further, such turnings meant increasing the cost of composting operations two- or three-fold, and thus rendering the manure too costly for purchase by our ryots.

As a result of detailed work on the subject carried out at the Institute by Dr. C. N. Acharya, a simple and satisfactory technique of compost-making was finally evolved, which dealt with town wastes such as *katchara* (sweepings and dust-bin refuse), night-soil, sewage and slaughter-house refuse, and converted them into good quality manure and at the same time fulfilled all the essential requirements of compost-making, such as:—(*a*) low cost of operations and cheapness of the product obtained; (*b*) completely sanitary and hygienic conditions, secured by rapid development of high temperatures above 70° C.,

which effectively destroyed fly-larvæ, pathogenic organisms, weed seeds and abnoxious constituents of town-refuse and night-soil; and (c) minimum losses of organic matter and of nitrogen.

The above process has been tested widely in the Bombay Province during the last one year, by nearly fifty municipalities in the Central and Northern Divisions, and has been adopted for routine operation by several of them, with highly successful results from the economic and sanitary points of view.

The present grant has been given by the Government of India with a view to extending the work carried out in the Bombay Province to other Provinces and States in India, and as a first step thereto undertaking the training of officers deputed from different parts of the country in the improved process of compost-making. It has been calculated that if the total urban refuse available in urban areas in this country could be converted into manure, it would ultimately be possible to supply nearly a crore of tons of good quality manure for agricultural purposes. Organic manure is of special importance in our tropical soils in improving the physical, chemical and biological properties of the soil and thus improving crop yields. If a cheap source of organic manure could be had from our town-refuse, it would go a great way to recoup the continuous drain which the towns are exerting on the surrounding agricultural area, and to stem the slow and steady deterioration that is taking place in the cropping capacity of our soils.

The main source of manure at present available for agricultural purposes is farm-yard manure, but the method of preparation adopted by the farmers in most areas of India is defective in that (a) the valuable urine fraction of cattle-excreta, which is rich in nitrogen, is almost completely lost; and (b) under the present arrangement of storage in big-sized round or square pits, the manure gets rapidly dried in the summer and washed by rain in monsoon time, involving in both cases loss of nitrogen and defective decomposition. Dr. Acharya has also developed an improved technique for the preparation of farm-manure by agriculturists, in which long trenches are used, which are filled up in portions from one end and plastered over with earth.

If the above improved methods for dealing with town and farm-wastes respectively, could be propagated widely in this country, it is felt that crop yields could be increased to such a level that the food problem would be automatically solved.

Lateral Eccentricity in a New Species of Pachydiscus from the Trichinopoly Cretaceous. Mr. G. Rukmangada Rao, Andhra University, Guntur, writes:—Lateral eccentricity of the shell has been previously observed in the Nautiloidea from the Cretaceous rocks of Trichinopoly. It is not infrequent in this order from these rocks. I have observed lateral eccentricity in a species of *Pachydiscus*, an ammonite from the Ariyalur group. By virtue of its recognition for the *first time* in the *ammonoidea* from these rocks and the differences this species has with the associated species, it has been isolated as a new species of Pachydiscus and called *Pachydiscus eccentricensis.* The type specimen is preserved in the Department of Geology, Benares Hindu University.

Soil Erosion in India.—Soil erosion, resulting from the neglect or destruction of the plant cover of hillsides, threatens to lay waste large areas in India, particularly in the foothills of the north and in parts of Central India. Not only would land in the hills be rendered useless for agriculture and growing timber but flood disasters in the plains would become more frequent and of greater magnitude, while irrigation supplies in the dry season would be reduced.

A note in Bulletin No. 37 of the Central Board of Irrigation stresses the need for a central co-ordinating authority to check erosion, pointing out that it is in the upper reaches of catchment areas, possibly lying within the territories of several States, where preventive measures are required and that with so many interests co-operation in a common policy is essential. The Board of Forestry has suggested the division of India into 13 units, each representing the catchments of a river or group of rivers and placed under a special officer to work in co-operation with the Forest, Agricultural and Irrigation Departments. With the willing co-operation of the Provinces and States concerned, large-scale measures can be organised to remove the threat of mass devastation and undo some of the evil caused by past neglect.

U.K.-U.S.A. Steel Mission.—Members of the U.K.-U.S.A. Steel Mission arrived in New Delhi this afternoon (June 4) for consultations with the Government of India. After a stay of about three days in New Delhi they will proceed to Calcutta for discussions with the Director-General, Munitions Production, and the Iron and Steel Controller.

The Members of the Mission are:—Sir John Duncanson, British Controller of Iron and Steel Supplies; Mr. Norman Anderson of the British Steel Control; Mr. A. E. Emerson, President of the American Rolling Mill Company; and Captain A. H. Gaal, a Metallurgist from the U.S.A.

The Mission has already visited the U.S.A. and Australia, and will proceed to South Africa after a short stay in India.

The purpose of their tour is to secure increased co-ordination of the Allied resources of steel supplies with the needs of all the Allied countries, and to discuss other more detailed problems concerning steel supplies in each country.

Cardboard from Coconut Fibre.—A new enterprise for manufacturing cardboard from coconut fibre in Ceylon has, it is reported, proved highly successful. The scheme was developed by Mr. S. R. K. Menon, an Indian Chemist, with the financial assistance of the Coconut Board of Ceylon. After certain preliminary experiments a pilot plant was established in Colombo and it is now able to turn out cardboard of high quality with a polished

surface. Proposal for manufacturing the material on a commercial scale is likely to be considered shortly by the Coconut Board. The new product is called 'Coconite'.

Lady Tata Memorial Trust.—The Trustees of the Lady Tata Memorial Trust announce the Awards of the following Scholarships and Grants for the year 1943-44.

I. International Awards for research in diseases of the blood with special reference to Leucaemias.

1. PROF. L. DOLJANSKI of Jersualem: To continue studies on (1) Leukotic cells and agent of fowl leukosis *in vitro*; (2) The X-ray susceptibility of leukotic agent; (3) The cell affinities of oncogenic viruses and the mutual relationship between Rous Sarcoma agent and agent of fowl leukosis. (*Grant of £400, Second Year's Award.*)

2. DR. JACOB FURTH, of American nationality, Cornell University Medical College, New York: To continue the work in progress upon the Leucæmias like diseases of fowls and their relation to neoplasms and to determine the nature of viruses producing leucæmias and associated neoplasms lymphomatosis, myelomatosis, endothelioma, sacromas, etc., etc. (*Grant of £300, Ninth Year's Award.*)

3. DR. P. A. GORER, Guys Hospital, London: To continue the studies in the genetics of mouse Leucæmia. (*Grant of £70, Fourth Year's Award.*)

4. DR. A. H. T. ROBB-SMITH, Nuffield Reader in Pathology and Morbid Anatomy, Oxford University: To continue the aid to the establishment of a "Lymphonode Registry" in the School of Pathology at Oxford to aim at better classification and follow up of human cases showing progressive hyperplasias and neoplasms of the lymphoreticular tissues including cases of the leucæmias, lymphadenoma, lympho sacroma, etc. (*Grant of £350, Fourth Year's Award.*)

5. DR. WERNER JACOBSON, Part-time Sir Hailey Stewart Fellowship at the Strangeways Research Laboratory, Cambridge: To continue the study of making a histo-chemical study of the argentafine cells of the gut epithelium, with a view to determining whether they are the source of the intrinsic factory of castle, and hence their bearing on the problem of pernicious anæmia and other blood diseases. (*Grant of £300, Sixth Year's Award.*)

6. DR. SYBIL WILLIAMS, Cambridge: To assist in the work of Dr. Werner Jacobson. (*Grant £400. Third Year's Award.*)

II. Indian Scholarships of Rs. 150 per month each for one year from 1st July 1943 for scientific investigations having a bearing on the alleviation of human suffering:—

1. MISS MARY SAMUEL, B.A., M.Sc.: To continue the research work on the effect of fat-soluble vitamins on the histology and cytology of the female gonad, under Prof. R. Gopala Aiyar, Director, University Zoological Laboratory, Madras. (*Second Year's Award.*)

2. MISS BEATRIZ DE MENEZES BRAGANCA, M.Sc.: To continue the work on Dietary factors in relation to Hæmopoiesis, under Prof. B. C. Guha, D.Sc. (Lond.), Ph.D., Head of the Department of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta. (*Second Year's Award.*)

3. MR. M. V. LAKSHMINARAYANA RAO, M.Sc.: To continue the research work on Insulin, Carbohydrate metabolism and the cure of Diabetes, under Dr. V. Subrahmanyan, D.Sc., F.I.C., Professor of Bio-Chemistry, Indian Institute of Science, Bangalore. (*Second Year's Award.*)

4. MISS B. S. ALAMELA, B.A., M.Sc.: To work on Synthesis and Biological Study of Sulphanilamide Derivatives, under Lt.-Col. S. S. Sokhey, M.D., I.M.S., Director, Haffkine Institute, Parel, Bombay. (*First Year's Award.*)

5. MR. AROBINDA ROY, M.Sc.: To carry out investigations on (*a*) The absorption rate of different edible oils used in India and the effect of Vitamins A and D and hydrogenation; (*b*) The metabolism of fat in some pathological conditions, namely, in experimental anæmia and diabetes and diphtheria toxæmia; (*c*) The determination of different components of the phospholipides in human blood in some pathological conditions, under Dr. B. B. Sarkar, D.Sc., F.R.S.E., Head of the Department of Physiology, University College of Science, 92, Upper Circular Road, Calcutta. (*First Year's Award.*)

6. MISS VIOLET DESOUZA, M.Sc.: To carry on investigation of a few promising strains of yeasts and their hybrids as sources of the Vitamin B complex, under Sir Jnan Chandra Ghosh, Kt., D.Sc., F.N.I., Head of the Department of General Chemistry and Director, Indian Institute of Science, Bangalore. (*First Year's Award.*)

University of Ceylon.—Under a new statute recently made by the University Court the following are now added to the degrees which the University may confer: Bachelor of Dental Surgery (B.D.S.) and Master of Dental Surgery (M.D.S.). It may be noted that these degrees are not conferred by many of the Indian Universities.

The University Senate has, it is learned, recommended the creation of four professorial chairs in Oriental Faculties for Sinhalese, Tamil, Pali and Sanskrit. It is possible that the Chair for Sanskrit may be filled from India.

A convocation of the University is to be held this month for the purpose of conferring degrees gained in recent examinations.

Indian Mathematical Society: Conference at Annamalainagar.—The authorities of the Annamalai University have invited the Indian Mathematical Society to hold its next conference at Annamalainagar about the end of December 1943, and the Society has accepted the invitation. It is also proposed to hold, in connection with the Conference a mathematical exhibition intended to illustrate the richness and variety of the subject and the wide range of its applicability to life situations. Suggestions regarding suitable items, as well as charts, models, instruments and other exhibits will be gladly received and exhibits on loan duly acknowledged and returned at the end of the Conference. It is also proposed to have a "book section" for exhibiting books on

mathematics. All correspondence relating to the Conference, and all papers to be read at the session may kindly be sent (with two short abstracts of each paper) to Dr. A. Narasinga Rao, Annamalainagar P.O., South India. It is hoped that, in spite of the difficult conditions under which the Conference and exhibition are held the enthusiasm and co-operation of members will make the venture a great success.

The Travancore University.—We are glad to announce that Dr. C. S. Venkakteswaran, M.A., D.Sc., has been appointed as Professor of Physics in the Travancore University. He will be placed in charge of the organisation of the newly started M.Sc. courses and will guide other post-graduate researches. Dr. Venkateswaran has been working in the Indian Institute of Science for the past ten years under the inspiring guidance of Sir C. V. Raman and has contributed several important papers on Raman Effect, Molecular Scattering of Light, X-Rays and other allied topics.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory, Bombay, during the month of May 1943, there were one of moderate and two of great intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin I.S.T		Epicentral distance from Bombay	Depth of focus	Remarks
		H.	M.	(Miles)	(Miles)	
2	Moderate	22	48	9820	..	..
3	Great	08	29	3470		..
26	Great	05	38	3930	100	Epicentral region near the Philippine Islands.

MAGNETIC NOTES

Magnetic conditions during May 1943 were slightly less disturbed than in the previous month. There were 13 *quiet* days and 18 days of *slight* disturbance as against 15 quiet days, 15 days of slight disturbance and one of moderate disturbance during May 1942.

The quietest day during May 1943 was the 9th and the day of largest disturbance was the 13th.

The individual days during the month were classified as shown below.

Quiet days	Disturbed days	
	Slight	Moderate
5-10, 20-22, 23, 26, 29-31.	1-4, 11-19, 21, 24, 25, 27, 28.	Nil.

No magnetic storms occurred during the months of May in the years 1942 and 1943.

The mean character figure for the month of May 1943 was 0·58 as against 0·55 for May of last year.

M. V. SIVARAMAKRISHNAN.

We acknowledge with thanks the receipt of the following:—

"Journal of Agricultural Research," Vol. 65, Nos. 7-10; and Vol. 66, Nos. 1 and 3.

"Agricultural Gazette of New South Wales," Vol. 54, Pts. 3 and 4.

"Indian Journal of Agricultural Science," Vol. 13, Pt. 1.

"Journal of the Indian Chemical Society," Vol. 20, Nos. 3 and 4.

"The Quarterly Journal of the Geological, Mining and Metallurgical Society of India," Vol. 15, No. 2.

"Bulletin of the Indian Jute Committee," Vol. 6, No. 2.

"The Review of Applied Mycology," Vol. 22, Pt. 2.

"Bulletin of the American Meteorological Society," Vol. 23, No. 7.

"Journal of Nutrition," Vol. 24, Nos. 4 and 5; Vol. 25, No. 1.

"Indian Trade Journal," Vol. 149, Nos. 1925-27.

BOOKS

The Genetics of the Mouse. By Hans Grüneberg. (Cambridge University Press, Bentley House, London), 1943. Pp. xii + 412. Price 30*sh.*

Intermediate Practical Physics. By Vissa Appa Rao. [Andhra University, Waltair, (Guntur)], 1942. Pp. viii + 337. Price Rs. 4.

Physics and Philosophy. By Sir James Jeans. (Cambridge University Press, London), 1942. Pp. vii + 222. Price 8*sh.* 6*d.*

Elementary Physical Chemistry. By M. Randall and L. E. Young. (Randall and Sons, California), 1942. Pp. xiv + 455. Price $4.50.

Forest Tree Seed, of the North Temperate Regions, with special reference to North America. By H. I. Baldwin. (Waltham, Mass: The Chronica Botanica Co.; Calcutta: Macmillan & Co., Ltd.), 1942. Pp. xvi + 240. Price $4.75.

ERRATA

Vol. 12, No. 5

Page 146, para 3, line 7: *For* 36 commutator segments *read* 18 commutator segments.

Page 155, columns 1 and 2; and page 156, column 2: *For* "$Y = ae^{-b}S$" *read* "$Y = ae^{-bS}$".

Page 157, Note entitled "Inclined Extinction in the Hypersthenes of Charnockites", Fig. 1, tilt zone 212-232 to be cozonal with zone 101-11.

568-43—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science", Bangalore

CURRENT SCIENCE

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ASTRONOMICAL RESEARCH IN INDIA: I

ASTRONOMY is the oldest of the natural sciences, its beginnings being traceable to the remotest periods of recorded human history. There is ample indication in ancient Sanskrit literature of the interest with which the subject was studied in India from the earliest times, while the later writings of Aryabhatta, Varahamihira, Brahmagupta and of Bhaskaracharya, which have come down to us, show that astronomy was actively studied in India at a time when the lamp of learning lighted by the ancient Greeks had burnt out, and Europe was passing through the dark ages. The vicissitudes of Indian history in the later centuries of the present millennium were not favourable to the development and expansion of cultural interests. Some indication that active interest in astronomy nevertheless did not altogether disappear in India is furnished by the astronomical instruments of an earlier era which have been preserved to us, and by the curious structures known as Jaisingh's observatories which are still to be seen at Delhi, Benares and Jaipur.

During the three hundred and odd years which have elapsed since Galileo first directed his little telescope towards the heavens, the progress of astronomical science has been of the most spectacular character. This progress has largely been the result of the success achieved in making bigger and better telescopes. A study of the fascinating autobiography of John A. Brashear—the American who loved the stars and made great telescopes for observing them—may be warmly recommended to any one who is interested in the development of astronomical research in India. It brings home to the reader the extent to which the progress of astronomical science in a country depends on the existence in it of skilled opticians who can grind, polish and figure great lenses and mirrors up to the most exacting requirements. Without telescopes, interest in astronomy must languish, and without an active interest in astronomy, there obviously can be no telescopes in a country. That was the vicious circle which Brashear sought to break in a spirit of genuine altruism. The immense interest in astronomical science and the generous support accorded to it by wealthy men in the United States of America must, to no small extent, be credited to the influence of Brashear's life and work. The making of great lenses and mirrors is practical optics on an engineering scale, and it is no accident that Brashear was a mechanical engineer before he became a maker of telescopes. The mounting and driving of telescopes is also mechanical engineering of a very exacting nature. In a modern observatory, the ton-loads of material making the telescope and its accessories move with the same accuracy and smoothness as the hands of a wrist-watch go round its dial. Optics and engineering are the handmaids of observational astronomy without whose services she cannot live and flourish.

It may be asked, why trouble about astronomy? Why spend money on making great telescopes and building great observatories? These are pertinent questions to which it is the purpose of this article to return an answer. My reply would be that an interest in astronomy is a part of the cultural heritage of India, and that we would be unworthy recipients of that heritage if we did not cherish that interest and do our utmost to promote the science. As has been truly said, man does not live by bread alone. Astronomy is not only the oldest but the grandest of the sciences. The interest which it evokes in all thinking and cultured minds is instinctive—an expression of man's desire to understand and comprehend the universe he lives in. Modern science is accused—perhaps not unjustly—of allying herself with powers of destruction and helping to make death-dealing weapons of all kinds. I do not know, however, of anyone who has had the hardihood of including the science of astronomy in such an indictment. Like all other sciences, astronomy is not without some practical applications—such as time-keeping and aid to navigation at sea—which have given it claims to support from public funds. But the real purpose of astronomy is very remote from such applications. Broadly, it may be described as the investigation of the nature of the physical universe. Defined in that way, we begin to realize that astronomy occupies the premier position amongst the sciences. Indeed, it may be described as a heaven-born river of knowledge which flows to the earth and fertilizes the fields of learning and culture. That this view of astronomy is fully justified will be evident to any one who makes a comprehensive survey of the history of modern science during the past three hundred years.

As some of the outstanding results of astronomical research which have influenced the orientation of scientific thought, we may mention the discovery of the finite velocity of light by Romer, of aberration by Bradley, of the laws of planetary motion by Kepler, of the dark lines in stellar spectra by Fraunhofer, of helium in the sun by Lockyer, of the magnetic field in sunspots by Hale, and of the recession of the nebulæ by Hubble. When we examine the structures of modern physical and chemical thought, we find that they are laid on foundations built out of the results of observational astronomy. *Vice versa*, observational astronomy calls to its aid all the resources of the experimental physicist, while astronomical thought and speculation have as their basis the well-established laws of experimental physics and chemistry.

It will be evident from what has been said that the organization of scientific research in India must be considered radically defective unless and until adequate provision is made for astronomical study and research of the highest grade in the country.

C. V. RAMAN.

Research has made available foods relatively new to our civilization not alone from the standpoint of new varieties but chemicals used for treatment increasing their quality, size and vitamin content. Gases such as ethylene, propylene and butylenes hasten fruit ripening and growth. Ethylene is used for ripening of oranges and for the growth of potatoes. It has been reported that the speed of growth of potatoes has increased 100 per cent. when the seedlings have been treated with ethylene. The growth time to maturity is shortened while at the same time the potatoes are more numerous and larger and contain higher percentages of vitamin C. Butylene gas has also a stimulating effect on the speed of growth of trees such as the apple. Acetylene is being used in Australia to increase the growth of pineapple plants. Calcium carbide is placed in the heart of the plant and rain or dew reacts with it to produce acetylene in sufficient quantities. In California fruit orchards are fertilised by ammonia added to irrigation water, which has markedly improved productivity. Colchicine, an yellow powder obtained from the autumn crocus plant, when applied to seeds, leaves or buds of plants, increases the growth of fruits and vegetables to double their normal size. Colchicine also gives rise to new varieties of fruits and vegetables never known before.

A number of processes have also been developed to dehydrate foods in order to cut down their weight and bulk. "Quick freezing" of fruits, vegetables and meat has added materially to food supply and also conserves steel and tin in the form of cans. The impact of these researches will develop enormously in that one may work out new hormones and chemical stimulators which will give rise to new plant life. Obviously also all these developments will make it possible to raise more food of higher nutritive quality on less acreage and with far less labour compared to present methods.—(According to G. Egloff, *Science*, 1943, **97**, 103).

POST-WAR PROBLEMS OF THE INDIAN LAC INDUSTRY

BY

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ALL indigenous products, agricultural, mineral and sylvan, have lost their foreign markets at the present moment, to a smaller or greater degree, and this has imposed a necessity for a review of the situation both during the war and after. In certain cases, the present difficulties have been a blessing in disguise in so far as they have provided an incentive for the development of industries in this country to produce out of the indigenous raw materials substitutes for many imported commodities. There is a great apprehension that some of these industries which the war has brought into existence will disappear at the cessation of hostilities, especially in cases where the present developments are based on uneconomical foundations. But one can safely assume that some at least of the many industries will survive and cater to the post-war needs of India. It can be assumed further that an improved standard of living, not improbable as a result of the war, will also contribute to the continuance of industries based on the proper utilisation of raw products in this country, and the most ideal position will be to so far improve the industries as to be able to create a certain amount of export market after the internal needs are met. Then again, it is extremely probable that at the end of the present war, under a new order of things, there would be certain large-scale basic industries in India, which would bring in their train several accessory industries. Industrial production of war materials will naturally decrease, but it would be difficult to imagine that some of them at least would not be capable of being turned over to the production of peace-time requirements, with a minimum of dislocation as regards plant and equipment. One hopes, at any rate, that a country like India, which as yet is not adequately industrially developed, and as such differentiates itself from the already fully industrialised counntries, would require every machine and plant installed during the present crisis for meeting her future industrial needs; this expansion will be aided also by the large number of technically trained personnel that will be released all of a sudden at the end of the war. It may be hoped, therefore, that the nightmare of a slump after the war may end in a pleasant and fruitful industrial awakening of the country.

Another view-point, which may be stressed in this connection, is that under existing world conditions it is absolutely essential in the interests of any country to organise its industries in such a way that, in case of aggression from other nations, it can always have the necessary potential for large-scale armament production. In this respect India had been woefully deficient in the past and to secure and maintain a position of safety, such new industries will have to be permanently established. It would be reasonable, therefore, to expect that certain war industries brought into being due to the present emergency would continue as such, though on a reduced scale and, if necessary, develop to a larger extent, so as to have the necessary provision for self-defence, although it may be felt that no country's peace is worth the name excepting in a comity of nations. It will be unwise to overlook that a minimum of war industries would always be a matter of national safeguard.

So far, India may be regarded mainly as an agricultural country without a proper agricultural industry. The by-products of agriculture and forestry would constitute raw materials for various industries and in this region lies the need for extensive theoretical and technical researches to be able to successfully utilise them. This would enable the country to minimise, if not altogether stop, the import of manufactured products based on natural or synthetic materials. The acid test will, however, always be whether indigenous manufacture could be effected at an economic level to face external competition. The position of lac is rather peculiar in that it is not a by-product but a raw material which has been in demand all over the world for the fabrication of many industrial articles. Whilst the use of the lac-dye (which was the main ingredient for which lac was appreciated in the past) has practically disappeared with the advent of synthetic dyes, the value of the lac resin itself has been recognised for more than forty years in certain specific industries where the synthetic resin has not as yet been able to make any substantial headway. The extraordinarily rapid development of the synthetic resin industry in foreign countries has not, however, created a fall in the demand for shellac as will be noticed from Table I.

Thus lac exported into foreign countries has been more than able to hold its position in the industries in which it was being used. And this, in spite of the fact that chemists by the hundred had been systematically exploring the possibilities of synthetic resins in various laboratories in the world during the period 1910-1926, when only occasional and small-scale researches were being carried out on lac. To mention only one example, more than 230 chemists and engineers were at one time or another engaged on the development of Nylon, the synthetic resin fibre, the total annual output of which is to-day about 7,000 tons. An inference may be drawn, therefore, that the position of lac after the present war will continue to be at least as good as before, if not better, on account of the very intensive research that is being lately carried out to find out newer uses of this resin.

The idea that every raw material or by-product should be fully exploited in the country

TABLE I

Exports of Lac (Crude and Refined) from India

Year	Weight	Value (Rupees in thousands)	Calculated price per cwt.
	Cwt.	Rs.	Rs. A. P.
Pre-war average— 1909-10 to 1913-14	434,351	22.015	54- 1-"9
War average— 1914-15 to 1918-19	345,376	25,706	74- 6- 9
Post-war years			
1921—22	434 934	79,158	198-11- 3
1922—23	476,011	102,562	242- 0- 7
1923—24	485,671	90,627	203- 3 0
1924—25	427,017	75,506	191- 3- 4
1925—26	539,924	69,010	138- 5- 3
1926—27	592,030	54,724	101-12- 3
1927—28	543,584	69,886	140- 9- 9
1928—29	743,403	86,426	128- 6-10
1929—30	668,914	69,672	113-13-10
1930—31	547,151	31.374	62- 6- 5
1931—32	463,724	18,394	43-11- 6
1932—33	418,300	12,424	31-13- 6
1933—34	730,545	24.624	33-11- 2
1934—35	585,194	33,110	56- 9- 3
1935—36	487,801	15,828	32- 7- 2
1936—37	836,405	23,494	28- 1- 5
1937—38	665,525	16,198	24- 5- 5
1938—39	642,054	12,639	19-10-10
1939—40	760,399	19,119	25- 2- 3
1940—41	597,864	22,543	37- 1- 1
1941—42	766,707	49,208	64- 2-10

of its origin, supported, if need be, by public and State patronage, is not as widely appreciated as it should be. Nor is there as much planning as is desirable for co-ordinating production of the same article by alternative methods. To secure the highest economic value of national industries, not only a good deal of adjustment on a wide scale and in details within the country is necessary but even the putting up of a temporary, high tariff-wall against foreign imports should not be stigmatised as a retrograde step. To face the competition of synthetic resins, industries based on lac must needs be carefully and almost affectionately protected during the earlier stages of their development.

The position of the shellac industry after the war has often been a subject of enquiry at the Indian Lac Research Institute. Whilst at the present moment an internal consumption of shellac to the tune of 33 per cent. of the total produce has been claimed by some authorities, there is no doubt that the pre-war figure of 2-3 per cent. home consumption has been very much exceeded and the demand for shellac still continues. This increased consumption is due to the establishment of several new industries in the country, which were hitherto unknown, as a result of researches carried out by the Indian Lac Cess Committee, the Board of Scientific and Industrial Research, and the Indian Institute of Science, Bangalore. Amongst the new materials may be mentioned a dressing for anti-gas fabrics, "windolite" varnish, laminated paper and jute boards, water-proof abrasive papers, water-proof book-binding cloth, bobbin enamels, shellac moulding powders—both injection and compression—emery grinding wheels, non-shattering petrol containers, artificial leather-cloth, insulating varnishes, plywood adhesives, enamels and lacquers for various metallic surfaces, radio parts, etc. If one scans this list, he would have scarcely any hesitation in concluding that excepting the consumption in anti-gas fabrics, the others would be permanent industries after the war, consuming a very considerable quantity of shellac in their manufactures. Thus, for example, the moulding industry for general purposes alone may consume as much as 1,000 tons of lac or 2,000 tons of Kiri, a by-product in the shellac industry; lac recovered from Kiri would cost only Rs. 10-12 per maund, a figure which can scarcely be approached by synthetic resins. This is the least quantity that one can reasonably think of, but there is every possibility that with an improved standard of living and a desirable economy in the conservation of metals, plastics from shellac would claim a larger and still larger share in the economy of life, provided also that intensive researches to better the properties of this unique resin are continued.

The economic aspect of shellac plastics should not be lost sight of to appreciate its future possibilities. Under normal conditions, shellac moulding powders could be produced at 2½-3½ annas per pound, whilst no powder based on a synthetic resin could be fabricated under twice that cost. As further researches are brought to bear on this problem, there could be no doubt that improvement in properties would ensue and popularity of shellac plastics would increase.

An industry of singular value and potentiality can be envisaged in laminated boards of paper and jute, the latter being an important Indian industry, the waste from which could serve as a raw material to be bonded with adhesives developed from shellac. The significance of shellac adhesives in their application in plywood industry cannot be overestimated, and recent researches at the Indian Lac Research Institute show excellent promise of a lac-*cum*-synthetic of high elasticity and toughness, the use of which in the manufacture of various parts of motor cars and aeroplanes may be envisaged. So is the scope of shellac for use in water-proof abrasive papers, artificial leather, book-binding cloth, oil-cloth, grinding wheels, stoving enamels and lacquers, of which large quantities are now being imported into this country.

As the use of electricity spreads into smaller towns and villages, and radio becomes more popular, the use of lac would multiply *pari passu*. The unique raw material, mica, which is so far exported into foreign countries, may then form the basis of an independent permanent industry in this country. In short, all the above industries arising out of the recent researches on the utilisation of lac, may be expected to be established on a sound basis in the post-war period.

In the appendix is given a comprehensive list* of the known uses of lac products which will indicate how versatile lac is for industrial applications.

Without going into further details, it may be emphasized at this point how important both fundamental and technical researches on lac are to ensure its large-scale application now and after the war. Every new application leads to further consumption of this unique resin and one could, in short, state that the share of this natural commodity in big industries will be determined by the already known properties of lac as also future modifications that may be brought about by intensive research.

The consideration of an economic price level for this resin is probably one of the most important to keep this material on the map; for, it must be admitted, that for the disposal of quite a considerable portion of the lac produced, we have as yet to look for export into other countries. So far, the cheaper synthetic resins may be priced at 9*d.* to 1 *sh.* per pound and to secure a progressive trade in shellac, after allowing for its various qualities above the synthetics as also its deficiencies in comparison with them, its (shellac) normal price should be of the order of 6 to 8 annas per pound, that is to say, Rs. 30 to Rs. 40 per maund. No doubt such prices have been available for shellac, but during the few years before this war the price of shellac reached a level as low as Rs. 14 per maund. The law of supply and demand must have mainly operated to bring down the price of shellac to such an uneconomic level, but with increased use of lac in newer industries there is the chance of an ever-widening field for its production and maintenance of a reasonably profitable price of Rs. 30-40 per maund in competition with the synthetic resins.

A question has often been asked: Is it possible to increase the production of lac to the same tune as the synthetics? To that the answer is: At present 40-50 thousand tons of lac are being annually produced as against 150-200 thousand tons of synthetics. *With a reasonably attractive price for lac,* it will be possible to reach this figure for synthetics in ten years. Some very interesting work of the Entomological Section of the Indian Lac Research Institute has already shown that by slight modification of the existing method of lac cultivation, about a third more of lac can be produced. The indiscriminate cutting down of *Ari* lac (immature lac) due to the poverty of growers, if once stopped by co-operative loans, would enable the growers to bring more trees under infection resulting in increased output. New cultural methods like artificial defoliation before the natural leaf-fall begins and partial pruning in early spring can considerably improve the yield of lac on trees carrying a crop.

As further researches enable us to have a real glimpse into the structure of shellac, it may be hoped that its constituents would be the starting material for new synthetic products and the now-forgotten dye, as far as signs show, may be the source of pharmacologically active preparations. During the War of 1914-18, it was feared that in the post-War period the demand for shellac would decrease due to the advent of synthetic resins, but curiously as mentioned before this did not happen. There is no reason, therefore, to anticipate any retrogression after the present war, more so, as newer avenues of the uses of lac are being opened up through the experiences of the present war. An industry the annual export value of the products whereof has been of the order of 4·6 crores of rupees on an average for 21 years, deserves more careful handling in the field as well as in the laboratory.

* "The Story of Lac," A. J. Gibson, *Journal of the Royal Society of Arts*, 1942.

APPENDIX

The Known Uses of Lac Products

A. Shellac Varnishes

(a) Spirit and Alkali Varnishes:—

I. Insulating varnishes and impregnating compounds—
  1. To prevent copper wire "greening": Hard lac—alcohol; Shellac—*p*-toluene sulphonamide.
  2. To resist effect of lubricating oils and greases: Shellac—alcohol; Lac—glycol ether in solvents.
  3. In micanite and micafolium: Shellac—alcohol (dry powdered lac).
  4. (i) In building up paper and fabric tubes and impregnating tape and fabrics: Shellac—alcohol; Shellac—glycol ether; Hard lac resin and alcohol; (hot spraying of dry powdered lac). (ii) Grease-proof paper: Bleached lac—alcohol.
  5. To resist high temperature: Shellac—glycol ether and alcohol.
  6. For brake linings: Shellac in solvents; Hard lac resin in solvents; Shellac—tung oil varnish.

II. Shoe Trade—
  1. Shellac stiffeners for toe and soles of shoes, etc.: in alcohol solutions; in ammonia solutions.
  2. Shellac varnishes and finishes: in alcohol solutions; in ammonia solutions; in borax solutions.

III. Leather Trade—
  Pigmented and unpigmented shellac finishes: in alcohol; in ammonia; Shellac—stearic acid compound; Shellac—metallic oxides and alcohol.

IV. Hat Industry—
  Felt and fur hats, service hats and helmets: Shellac and bleached lac: in alcohol solutions; in borax solutions; in other alkaline solutions.

V. Photographic Industry—
  1. Negative varnish: Shellac—alcohol.
  2. Anti-halation plate and film backing: Soft lac resin in alkali solution; Hydrolised lac in alkali solution.
  3. Dry mounting paper: Paper tissue impregnated with: Bleached lac—alcohol solution.
  4. Preparing photographic graticules: Shellac solutions.
  5. Photosensitizing processes: Cold tops in photo-engraving and etching; Shellac—

alcohol; Hard lac resin—alcohol; Shellac in aqueous ammonia and ammonium dichromate.

6. For protecting sound tracks on "talkie" films: Dewaxid shellac—nitro-cotton and solvents.

VI. Protective coatings for wood, paper, metal, and fabric—

1. French polish: Shellac—alcohol; Hard lac resin—alcohol; Shellac—metallic oxides and alcohol; Bleached lac—alcohol; Shellac—urea and alcohol; Shellac—alcohol—ammonia.
2. In medicine: For semi-rigid bandages; for coating pills; Shellac in alcohol.
3. In confectionary: Glazing candies and chocolates; Shellac in alcohol; Bleached lac in alcohol.
4. For burnishing coffee beans: (Dry powdered shellac).

VII. Polishes and finishes generally—

1. Shellac—esters: Rosin-shellac ester in turpentine and white spirit; Shellac—stearic acid ester as above.
2. Shellac—sodium bisulphite: for distempers; for coatings resistant to petrol.

(*b*) *Shellac Varnishes: Other Types*:—

1. For spraying: Cellulose nitrate—shellac and alcohol plus other solvents; Ethyl cellulose as above; Bleached lac as above; Dewaxed lac as above.

(*c*) *Shellac Oil Varnishes*:—

1. For general application: Shellac—drying oil—fatty acid—glycerol; Shellac esters—mono- and polyglycerides—drying oils.

(*d*) *In Inks*: Waterproof ink; Coloured inks; Lithographic inks; Shellac in alkali or alcohol solutions with other materials.

(*e*) *In Paints*: Antifouling compositions: Road paints: Solutions of shellac with other materials, poisons, pigments, etc.

B. Shellac Cements and Adhesives

1. For glass to glass, glass to metal, metal to metal, etc.

Cements:—Dekhotinsky cement: Shellac—pine tar; Pettman's cement: Shellac—Stockholm tar; Laboratory cement: Shellac—Venice turpentine; Shellac—lac-glycol ester; Electric bulb cement; Shellac—marble powder-zinc oxide and alcohol.

Adhesives:—Shellac—tartaric acid and alcohol; Shellac—rubber latex and ammonia; Shellac rubber and solvents; Dewaxed lac—lac glycol ester.

2. For abrasive wheels, emery paper, blackboard surfaces: Shellac—alcohol. Hard resin—alcohol; Hard lac resin—urea and alcohol.
3. Sealing wax: (i) As such: Shellac with fillers; Bleached lac with fillers. (ii) In turnery and toys: Shellac and colouring media; Coloured dry lac, in sticks.
4. Optical instruments: Shellac in alcohol; modified lacs.
5. Semi-rigid and flexible cements: To resist various solvents: modified lacs; Shellac—lac acids and glycol ester.
6. For rubber manufactures: (1) Rubber soles and heels; (ii) Rubber sheet: modified lacs and shellac; (iii) for rubber surface lacquers: Lac glycol ether with nitro-cellulose in solvents.

C. Shellac Mouldings

For Gramophone Records; 46 Electrical uses; Dominoes; Draughtsmen; Dental plates; Shellac in various forms: (1) Open moulding; (ii) Closed moulding; (iii) Injection moulding.

Shellac, hard lac resin and modified lacs in combination with: Stearic acid; Fillers, micronized mica; Phenol formaldehyde; Formaldehyde; Urea; Melamine; Protein; Cashewnut shell oil; Jute.

D. Other Uses

Bengal and signal lights and rockets; Pyrotechnics generally; in foundry work; Playing cards finish; Stiffening crepe; American cloth, Waterproof silk and sou' wester finishes; Sweets and cheese metal foil finishes; Hard lac resin in alcohol.

Tank steamer coatings: Shellac; Hard lac resin; Modified lacs.

Lac products as starting materials for synthesis:—Cosmetics: Hair dyes; Finger-nail polishes. Shellac in solvents; Hard lac resin in solvents.

E. Bleached Lac (48)-(50)

Seedlac or shellac dissolved in alkali, bleached with chlorine precipitated with acid, washed and dried and sold in powder or hanks.

Used principally in categories A, B and D of the chart. Annual production 7,000 tons, principally American; Bleached hard lac resin; Bleached soft lac resin.

"The history of research is full of men who duplicated Columbus' experience of hunting for a trade route and finding a continent. It was through effort to create synthetic rubber that the quick-drying lacquers, which have meant so much to the automobile industry, were developed. J. W. Hyatt started experiments to produce synthetic billiard balls, but accidentally developed a material for making non-wilt collars and cuffs instead. Then Doctor Baekeland came along with an idea for synthesizing phenol and formaldehyde, but developed a material which makes the ideal synthetic billiard ball, through the discovery of *Bakelite* phenolic resinoids. Acheson started out to improve the production of graphite, cooked some coke and sand together, and produced silicon carbide instead. In our own work on fuels, it was an incorrect theory that led us directly to the discovery of the first anti-knock compound, iodine, and later put us on the right track to tetraethyl lead. The point I want to make is that though you end up one hundred and eighty degrees from the thing you may have aimed at, you do end up with something, if you keep working."—(Charles F. Kettering in "Prospecting for Knowledge" in the *Bakelite Review*, Jan. 1942.)

LETTERS TO THE EDITOR

A SIMPLE OPTICAL METHOD OF DETERMINING YOUNG'S MODULUS

Many simple methods are available for the determination of Young's Modulus, but most of these require a considerable length of the wire whose Young's Modulus is to be determined, if sufficient accuracy in the value of this constant is desired. The method described in this note is suitable for small lengths of wires and gives reasonably accurate results.

Fig. 1 shows the arrangement of the apparatus. A glass cube C is mounted on a drum D which is rigidly fixed to a frictionless wheel F. The latter is free to rotate about the axis of the drum D. One end *a* of the experimental wire is fixed to a rigid iron-bracket W fixed in the wall. At the point *b* the wire is fixed to the drum D by means of a screw

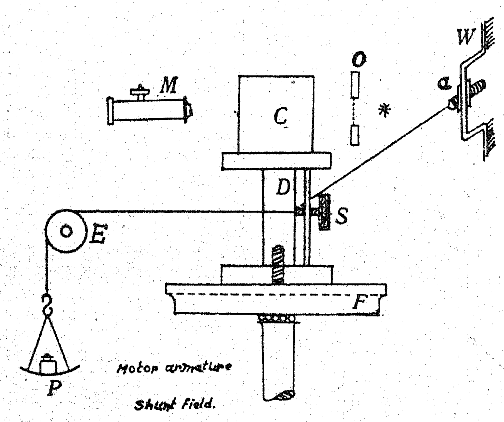

Fig. 1

arrangement and it is then taken round the drum in such a way that the two parts *ab* and *b*E are at right angles to each other and in the same horizontal plane. A scale pan P is attached to the end of the wire passing round the pully E. A travelling microscope M reading upto 0·002 cm. is used to measure the lateral shift of the image of an object (a fine thread) illuminanted by a lamp. The lateral shift, caused by the refracting glass cube C, being at right angles to the axis of the microscope, the latter is accurately set so as to have its motion exactly perpendicular to the incident ray. Fig. 2 gives a sectional view of the apparatus as seen vertically from above. The dotted square is the glass cube C and the dotted circle is the drum D (with its centre at Q) round which the wire passes.

When a load is added to the pan P the part *ab* of the experimental wire is stretched and hence the drum D is rotated in the direction shown by the arrow in Fig. (2).

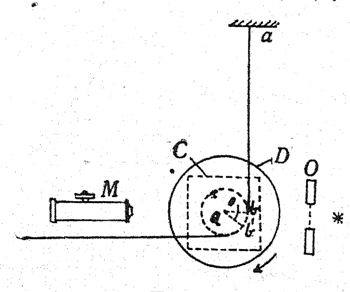

Fig. 2

In order to know the relation between the lateral shift of the image and the angle of rotation θ of the drum D or the glass cube C a preliminary experiment was performed with the glass cube C mounted on a spectrometer table. A graph of lateral shift against the angle of rotation was carefully plotted so that one could read from the graph a rotation up to half a minute and a lateral shift up to 0·002 cm. with sufficient accuracy.

A typical set of observations for a piece of brass wire is given in Table I.

TABLE I

Load in gm.	Loading: Shift in cm.	Loading: Shift for 300gm. in cm.	Unloading: Shift in cm.	Unloading: Shift for 300gm. in cm.	Mean value of the shift for 300gm. in cm.	Grand mean of the shift for 300gm.
0	10·354		10·352			
100	10·344		10·342			0·035
200	10 332		10·330			cm.
300	10·320	0·034	10·318	0·034	0·034	$\therefore \theta =$
400	10·308	0·036	10·306	0·036	0·036	1° 12·5′
500	10·296	0·036	10·296	0·034	0·035	from the
600	10·284	0·036	10·284	0·034	0·035	graph

Radius of the drum D = 1 cm.
Material of the wire, = Brass.
Length ,, ,, ,, l = 50·3 cm.
Radius ,, ,, ,, r = 0·015 cm.
Hence the extension ,, x = 0·0211 cm.

$$\text{Young's Modulus} = \frac{wg/\pi r^2}{x/l} =$$

$$= \frac{300 \,.\, 980 \,.\, 50{\cdot}3}{3{\cdot}142 \,.\, 0{\cdot}015^2 \,.\, 0{\cdot}0211} = 9{\cdot}92 \times 10^{11} \text{ dynes/cm.}^2$$

This method was used to determine the values of Young's Modulus for different metals generally used in the laboratories, *viz.*, Iron, Copper, Eureka, etc., and Table II gives a summary of the results obtained.

TABLE II

Material of the wire	Young's Modulus in dynes per cm.^{2}
Irom	$20{\cdot}18 \times 10^{11}$
Brass	$9{\cdot}92 \times 10^{11}$
Copper	$10{\cdot}91 \times 10^{11}$
Eureka	$16{\cdot}86 \times 10^{11}$

It seems possible that with little refinement, the method could be used to determine the Y.M. of thin glass fibres, silk threads, hair, etc.

I am indebted to Dr. D. V. Gogate for his useful suggestions and advice throughout the course of this work. My thanks are also due to Mr. L. V. Deshpande, B.Sc., for his help in taking some of the observations.

Physics Department,
Baroda College,
Baroda,
May 25, 1943.

K. R. CHAUDHARI.

CONTINUOUS EMISSION BANDS IN THE SPECTRUM OF CCl_4

IN the course of an investigation on the high frequency discharge through stagnant and flowing CCl_4 vapour, we have observed a number of continuous bands as also reported by Asundi and Karim[1] in the emission spectrum of a discharge through flowing vapour of CCl_4. Table I summarises the data on the maxima of these bands and their features.

TABLE I

Numbers indicate wavelengths in Å of maxima

Asundi and Karim[1] (*a*)	Here (*b*)	Intensity (*c*): Flowing vapour	Intensity (*c*): Stagnant vapour	Cameron and Elliot[2] (*d*)
4600	4620	Strong	Strong	—
3348	3340	Weak	Absent	—
3070	3060	Strong	Strong	3063
—	2960	Weak	Absent	2957
—	2870	V. Weak	Absent	2881
2580	2560	Strong	Strong	2564
2430	2450	Weak	Weak	2432
2300 ?	—	—	—	—

(*a*) Read off from microphotometer curves.
(*b*) Read off from wavelength scale on spectrogram on a Hilger baby quartz spectrograph.
(*c*) Visually estimated only.
(*d*) From microphotograms of spectra, of high frequency discharge in chlorine gas.
? Doubtful.

It will be seen that all the bands except the two at 4620 Å and 3340 Å, are identical, within the limits of error, with those obtained in a discharge through chlorine. They are, therefore, in all probability due to Cl_2 or $Cl_2{+}$. Such an interpretation of band at 2564 Å, is given by Cameron and Elliot.[2] Only the bands 4620 Å and 3340 Å are, therefore, to be regarded as characteristic of the CCl_4 discharge. They probably involve emitters containing both carbon and chlorine.

Asundi, *et al*'s[3] interpretation of the continuous bands observed in the spectra of flowing vapours of $SnCl_4$, etc., can be extended to the CCl_4 bands at 4620 and 3340 Å. Making use of the Born-Haber cycle and the various available thermochemical and spectral data required, the energy of dissociation of CCl_4 into unexcited atoms can be calculated. Using arguments exactly analogous to those for $SnCl_4$ it is possible to construct the simplified Franck-Condon diagram illustrating the intermediate steps of dissociation through which CCl_4 may be supposed to pass. Here, a knowledge of the internuclear distance C-Cl in CCl_4 and in CCl is helpful in drawing the curves rather accurately. It is found that it is possible to interpret the

strong band at 4620 Å as the result of a transition in the CCl_4 molecule from the ground level of CCl which is also known by its discrete bands, to the repulsive curve of CCl_3; and the weak band at 3340 Å, similarly to the transition from the same initial level to the repulsive curve of CCl_3, in complete analogy to the continuous spectra in $SnCl_4$.

College of Science,
Benares Hindu University,
June 9, 1943.

R. K. ASUNDI.
NAND LAL SINGH.
JAGDISH PROSAD MISHRA.

1. Asundi and Karim, *Proc. Ind. Acad. Sci.*, 1937, **6**, 328. 2. Cameron and Elliot, *Proc. Roy. Soc.*, 1937, **158 A**, 681; 1939, **169A**, 463. 3. Asundi, Karim and Samuel, *Proc. Ind. Acad. Sci.*, 1940, **12**, 513.

SPERM DIMEGALY IN *ICHTHYOPHIS GLUTINOSUS* LINN.

SPERM DIMEGALY or polymegaly appears to be unknown in the Apoda. Examination of *Ichthyophis* material revealed a number of dimegalous sperms of this animal. Scattered amongst the normal sperms in the testis, there occasionally is a sperm with a conspicuously large nucleus and which, on closer examination is seen to be double in respect of the "middle piece" and axial filament but single in respect of the nucleus and the acrosome. Such a sperm is shown in Fig. 1.

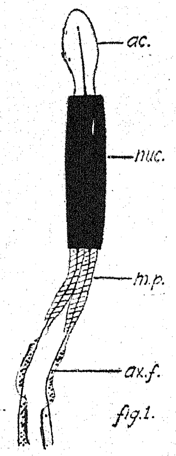

FIG. 1

Dimegalous sperm of *Ichthyophis glutinosus* × 2250

ac.—acrosome. *ax. f.*—axial filament. *m. p.*—middle piece. *nuc.*—nucleus.

It is generally known that in dimegaly, whether pathological or physiological, one or both divisions are suppressed in meiosis with the result that large-sized cells (primary or secondary spermatocytes) proceed to give rise to sperms by spermateleosis. Such di- and polymegaly has been known among insects, particularly the Hemiptera, where large giant spermatids derived from spermatocytes, either without any division or by fusion after division, proceed to give rise to giant spermatozoa.

The sperm figured above is a typical dimegalous one of *Ichthyophis.* The axial filament as well as the 'middle piece' is double while the nucleus and acrosome are single. But the noteworthy fact about both the nucleus and the acrosome is that they are double the normal size of these structures. The nuclear volume of a normal sperm of *Ichthyophis glutinosus* has been determined by me* to be about 25·1 cubic microns, while that of the dimegalous sperm described above is 49·9 cubic microns, nearly double that of the normal sperm. In the matter of the acrosome also, its size is very much larger than that of the normal sperm though I have had no means of calculating the actual volume of this structure.

Department of Zoology,
Central College,
Bangalore,
June 19, 1943.

B. R. SESHACHAR.

* Seshachar, B. R., *Proc. Ind. Acad. Sci.*, 1943, **27**, Sec. B. No. 5, 138.

DEGRADATION OF CHLOROPHYLL DURING TEA FERMENTATION

IN the manufacture of black tea the fermenting leaf changes its green colour to a coppery red tone. A rough estimation of this change of chlorophyll has been carried out by Carpenter,[1] Bokuchava,[2] as also in this laboratory, which show that the leaf loses about three-fourths of its chlorophyll during a four-hour fermentation.

Steaming arrests these changes completely, which indicates that an enzyme is concerned in the breakdown of the chlorophyll.

The degradation of chlorophyll may involve (1) formation of pheophytin by removal of Mg by plant acids, (2) hydrolysis by chlorophyllase whereby phytol is removed and (3) oxidation as a result of which the phase test is no longer obtained. Of these, that which tea leaf chlorophyll undergoes during fermentation appears to be limited to the last-mentioned. There was no evidence for the presence of chlorophyllase in tea. No pheophytin was detectable in the acetone extract of crushed leaf either before or after fermentation. During *in vitro* experiments the disappearance of green colour coincided with lack of response to the phase test, indicating an oxidation reaction. This was further confirmed by the fact that hot saponification of the 'fermented' chlorophyll product followed by treatment with acid did not yield phytochlorin *e* and phytorhodin *g*.

The mechanism of oxidation of chlorophyll appears to be as follows:

$$\text{Tea tannin} + O_2 \xrightarrow{\text{Polyphenol oxidase}} \text{O-Quinones}$$

$$\text{O-Quinones} + \text{Chlorophyll} \longrightarrow \text{Tea tannin} + \text{chlorophyll oxidation products}$$

Evidence for this lies in the fact that in the absence of tea tannin, chlorophyll is practically unaffected by tea enzyme. Moreover pure p-Quinone can effectively replace the system tea tannin + oxidase to give the same reaction as the latter with chlorophyll.

The disappearance of the green chlorophyll is a valuable indication of the progress and completion of tea fermentation which proceeds contemporaneously. It is easier to decide whether the greenish tint has disappeared than to judge whether a particular colour intensity of the insoluble oxidation products has been attained by the leaf residue. Tea tasters use this empirical colour test, the relevance of which this note explains, and deprecate any tea whose "infusion" (*i.e.*, spent leaf in their terminology) shows green tint after pressing out the liquor.

The insoluble 'infusion' pigment cannot, as suggested by Popatov[3] be a melanin produced by an enzymic oxidation of tyrosin which is supposed to arise from the breakdown of leaf proteins; for tea leaf not only does not contain tyrosinase but also the quantity of tyrosin liberated would be, if any, extremely small. The degradation of chlorophyll and the production of insoluble and coloured tannin oxidation products during the course of fermentation provide a more satisfactory explanation of the brown pigment in spent leaf.

Tea Research Institute
of Ceylon,
Talawakelle,
Ceylon,
June 10, 1943.
H. B. SREERANGACHAR.

1. Carpenter, *Ann. Rep. Ind. Tea Assoc.*, 1930, 12. 2. Bokuchava, *The Biochemistry of Tea Production*, Moscow, 1935, p. 62. 3. Popatov, *The Biochemical Basis of Technology of Tea*, Tiflis, 1932.

INFLUENCE OF THE SIZE OF EXCHANGEABLE IONS ON THE PERMEABILITY OF SOILS*

IT is well known that the colloid-chemical properties of soils are greatly influenced by ions that enter the base exchange complex. Analogous ions affect these properties in a regular manner. Various lyotropic series have been formulated with reference to some specific property of the soil. Thus soils saturated with monovalent cations show a tendency to disperse in the order:

$$Li > Na > NH_4 > K > Rb > Cs.$$

Ram Das and Mallik[1] report that the swelling effect decreases with the atomic weight of the metallic radical, that is, in the order:

$$Li > Na > K > Rb > Cs.$$

A similar variation in the ζ-potential of the soil colloids saturated with these ions has been noticed by Hans Jenny,[2] according to whom the ζ-potential is an exponential function of the adsorbability of the ion which saturates the soil complex.

We have attempted to study the influence of the size of cations on the permeability of a soil. The soil was leached with N/20 HCl to remove $CaCO_3$ and to saturate the soil with hydrogen ion. After being washed with water it was divided into five portions. Each portion, which weighed approximately 15 to 20 gms., was leached with 2 litres of normal solutions of the chlorides of Lithium, Sodium, Ammonium, Potassium and Rubidium. These samples were then washed first with water and finally with alcohol until free from chloride and dried at 100° C.

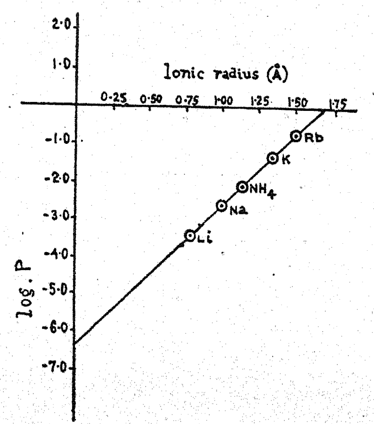

FIG. 1

The rate of percolation of water in each soil was then determined. For this purpose 10 gms. of the soil were placed between layers of sand in the experimental tube which was closed by a piece of muslin tied at the lower end. After wetting the sand and soil the same head of water (5 inches) was maintained in each and the rate of percolation was measured by noting down the sinking of the level of water. (To minimise the effects of evaporation the upper end of the tube was closed by a cork provided with a capillary tube). Table I gives the values obtained:

TABLE I

Ion	Radius Å	Rates of percolation (inch/hour)	
		Observed	Calculated
Li	0·78	·0005	·00048
Na	0·98	·0027	·00272
NH_4	1·14	·0115	·01084
K	1·33	·0600	·05598
Rb	1·49	·2250	·2239

It is evident that the rate of percolation follows the order of increasing ionic radius. If P be the rate of percolation and r the radius of the ion, the observed values can be correlated by the exponential equation $P = \lambda e^{\mu r}$. The constants λ and μ are determined graphically and the values of P recalculated from the equation $P = (50 \times 10^{-8})\, e^{8 \cdot 63 r}$ are given in the last column of Table I.

In Table II corresponding results obtained with soils saturated with the divalent alkaline earth cations are reported.

TABLE II

Ion	Radius of the ion Å	Rate of percolation of water in inch per hour	
		Observed	Calculated
Mg	0·65	0·150	0·153
Ca	0·99	0·275	0·272
Sr	1·13	0·350	0·345
Ba	1·35	0·500	0·504

It is significant that the percolation rate follows the order

$$Ba^{++} > Sr^{++} > Ca^{++} > Mg^{++}.$$

The observed rates conform to the relation

$$P = 0{\cdot}127\, e^{1{\cdot}705r}.$$

It is clear that the rate of percolation is an exponential function of the radius of the ion which saturates the soil complex.

Chemistry Department,
Lucknow University,
June 2, 1943.
M. R. NAYAR.
K. P. SHUKLA.

* This work has been carried out under the auspices of the Irrigation Dept. (Research Section), U.P. Government.

1. Ram Das and Mallik, *Proc. Ind. Acad. Sci.*, 1942, **16**, 1. 2. Jenny and Reitmer, *J. Phy. Chem.*, 1935, **39**, 593.

ZODIACAL LIGHT AT POONA

ZODIACAL light has been discussed from many points of view by various people.[1,2,3] In this note the intensity of the Zodiacal light as seen at Poona in the evening after sunset on a moonless night at the western horizon like a dome vertically up has been studied visually. The maximum intensity of the Zodiacal light at different hours is compared with that of the star canopus, the observations being made from the second floor of a certain building (Wakekar's quarter) some forty feet high from the ground, on the Fergusson Road.

Table I gives the intensity of the Zodiacal light on 4-4-1943 from 20·55 hours to 21·30 hours I.S.T., that of canopus being taken as 10. Graph 1 shows the relation between the time and the intensity as given in Table I.

TABLE I

Time in I.S.T.	20·55	21·00	21·05	21·10	21·15	21·20	21·25	21·30
Intensity of Zodical Light	4	3	2	2	1	·8	·6	·6

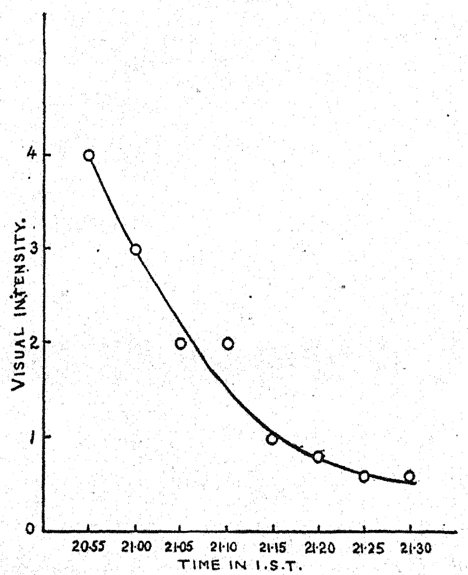

FIG. 1

Weather Office,
Poona,
May 10, 1943.
JAGDEO SINGH.

1. *Science and Culture*, 1939–40, **312**. 2. *Meteorology* by A. E. M. Geddes, p. 342 (Plate XX facing p. 342). 3. Spectrum of night sky and Zodiacal light—c Hoffmeister, *Zeits. f. Astrophysik*, 1939, **19**(2), 116–131.

ALGAL STRUCTURES FROM THE CUDDUPAH LIMESTONES (PRE-CAMBRIAN), SOUTH INDIA

IN the course of a detailed examination of some of the limestones from the lower Cuddupahs collected from near Royalcheruvu,

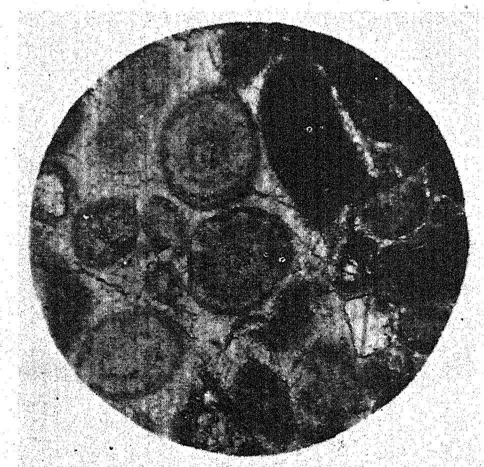

FIG. 1

Anantapur District, certain remarkable algal structures have been noticed. In hand specimens, the limestone is a dark coloured fine-grained marble, showing in places an oolitic

structure. When examined under the microscope, sections of the rock are seen to be crowded with fragments of varying shapes and diameters, and quite distinct from the oolitic structures. On closer examination, they show characters distinctly suggestive of the thallus of primitive algæ. One of them shown in Fig. 1 clearly shows a central cavity with a number of dark circular bodies arranged regularly along the periphery, the entire structure strikingly resembling a cross-section of the thallus of a Dasycladacea.

The author is grateful to Professors B. Sahni and S. R. N. Rao who very kindly examined the slides and agreed that the structures referred to above are of plant origin. The discovery of recognisable organic structures in these Pre-Cambrian rocks of India is evidently of considerable interest and importance, and a fuller paper dealing with this material will soon be published elsewhere.

Department of Geology,
Central College,
Bangalore,
July 12, 1943. M. R. SRINIVASA RAO.

A NOTE ON THE DISCOVERY OF APTEROUS MALES IN THE PINK MEALY-BUG OF SUGARCANE, *TRIONYMUS SACCHARI* CKLL. (COCCODÆ HOMOPTERA)

THE adult males in Coccidæ are generally winged, while the females are wingless. In some genera, like *Fonscolombia*, however, the males are always apterous, while in others (*Tachardinæ*) the males are sometimes so. Apterous and winged males are also said to occur in the genus *Gossyparia* which belongs to the Sub-Family *Dactylopinæ*. In the case of *Aclerda berlesei*, Leonardi (1920) mentions

FIG. 1

the existence of males with atrophied wings besides the winged ones. Herbert (1924) reports forms representing varying gradations between the winged form and the apterous condition.

There appears to be no previous record of the occurrence of apterous males in *Trionymus sacchari* Ckll., either from this country or elsewhere. While studying the biology of the pink mealy-bug some forms came under observation which when examined microscopically, resembled in all essential respects, the alate male except in the possession of wings and compound eyes (Fig. 1). The cuticle of this apterous form is not sclerotised in the principal regions of the body, the three penultimate abdominal segments bear a pair of long setæ like those of the adult female, a pair of ocellanæ present but compound eyes absent, antennæ have eight joints instead of ten in the winged male. Spiracles, legs and stylus of the wingless male do not differ in any essential respects from those of the winged one. The apterous male of *T. sacchari* resembles that of *Stomococcus plattani*.

Imperial Sugarcane Station,
Coimbatore, S. RAM MOHAN RAO.
June 18, 1943.

1. Leonardi, G., *Monografia delle cocciniglie italiane*, Portici, 1920. 2. Herbert, F. B., "The European Elm Scale in the West", *United States Dept. Agri.*, *Dept. Bull.* 1924, No. 1223.

ARTIFICIAL GERMINATION OF RICE POLLEN

IN view of the importance of pollen viability tests to rice breeding, a detailed study of the optimum conditions for artificial germination of the pollen was undertaken. The combination of various culture media, temperature and humidity were re-tried but without satisfactory results. The following technique was, however, found to give consistently better results and uniform germination.

The experiments by the author have shown that given proper humidity and temperature, the rice pollen germinates without any culture solution. The humidity required is 100 per cent., but it is important that it is not supplied by a sheet of water directly below, as when humidity was supplied this way, the percentage of bursting was very high. After

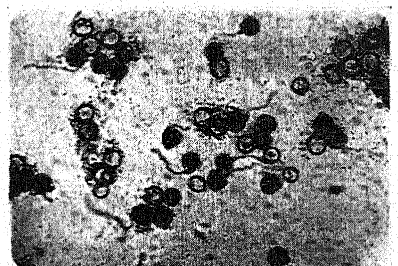

FIG. 1
Germinating pollen grains × 135

a number of trials it was found best to germinate the rice pollen inside a desiccator. The bottom of the desiccator is fielled with water and a layer of filter-papers or a pad of cotton wool soaked in water is placed inside the

desiccator. The pollen is dusted over a glass slide and the slide placed (pollen side upwards) on the filter-paper. The desiccator is then placed inside a chamber in which a temperature of 28° C. or 29° C. is maintained.

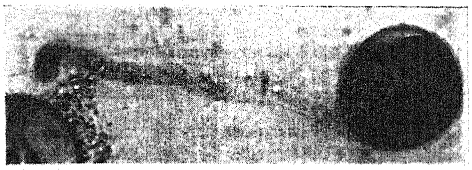

FIG. 2

A highly magnified pollen tube of average length × 950

Grown in the above manner, the rice pollen has been giving consistently from 50 per cent. to 60 per cent. germinations and the length of the tubes has been about 130 μ to 140 μ with a maximum of 238 μ. Unlike other methods, this technique has yielded consistent and reproducible results.

My thanks are due to Mr. C. R. Srinivasa Ayyangar and to Mr. N. L. Dutt for help and advice.

Paddy Section,
Agricultural Research Institute,
Coimbatore, M. K. VENKATA SUBRAMANIAN.
May 15, 1943.

ON THE ACTIVE PRINCIPLES OF THE BARK OF *AEGLE MARMELOS* CORRÊA

Ægle marmelos (family: *Rutaceæ*), commonly known as Bael, is indigenous to India and is reputed to be a valuable Ayurvedic remedy for various intestinal complaints. The bark as well as the fruits, both ripe and green, have been used for this purpose.[1] A chemical examination of the fruits by various workers has revealed the occurrence of a coumarin[2] (marmelosin) identical with a furocoumarin (imperatorin)[3] isolated from *Imperatoria ostruthium*[4] and *Angelica archangelica*.[5] As, however, no chemical examination of the bark has so far been reported, the present investigation was undertaken.

The barks of young and old plants procured from different places in Bengal and Bihar were sun-dried and the following five active principles isolated in a pure state, employing the usual methods of separation.

The young barks of both Bengal and Bihar gave (*i*) a coumarin (A) (yield—0·03 per cent.), which crystallises, has shining silky needles, m.p. 123° C. from ethyl acetate, acetone and petroleum ether; (*ii*) an alkaloid (B) (yield—0·003 per cent.) as rhombic plates, m.p. 175° C.; and (*iii*) umbelliferone (7-hydroxy coumarin). The old barks of both regions gave the same umbelliferone (*iii*), but (*iv*) a different coumarin (C) (yield—0·6 per cent.) which crystallises as colourless shining rods, m.p. 187-188° C., from alcohol, acetone and benzene. The same alkaloid (B) was yielded by the old barks of Bengal, but those of Bihar gave (*v*) a new alkaloid (D) (yield—0·3 per cent.), which crystallises as thick colourless plates, m.p. 142° C., from alcohol and ethyl acetate. It would appear from the above facts that not only the age of the plant, but also ecology plays an important role in the biogenetic synthesis of active principles in plants.

Further work is in progress.

The author is indebted to Prof. P. C. Mitter for laboratory facilities and to Dr. P. K. Bose for advice and encouragement.

University College of Science
and Technology, Calcutta,
April 26, 1943. (MISS) ASIMA MOOKERJEE.

1 Kirtikar and Basu, *Ind. Medicinal Plants*, **1**, 499. 2. B.B.L. Dikshit and S. Dutt, *J. Ind. Chem. Soc.*, 1930, **7**, 759; 1932, **9**, 271. 3. E. Späth, P. K. Bose, W Grüber and N. C. Guha, *Ber.*, 1937, **5**, 1021. 4. E Späth and H. Holzen, *Ibid.*, 1933, **66**, 1137. 5. E Späth and F. Vierhapper, *Ibid.*, 1937, **70 B**, 248.

PRODUCTION OF PENICILLIN

THE yield of the unstable Penicillin is found to be generally small and the process is lengthy, requiring an incubation period of 12 days at 24° C. on modified Czapek-Dox media.[1] Hobby *et al.*[2] reduced this period to 8 days by using brown sugar instead of glucose. Challinor[3] has reported that this time could be still further reduced to 5 days by adding small amounts of metabolic solution from previous batch to the culture vessel before seeding with *Penicillium notatum*.

All the previous workers have grown the fungus in liquid sugar media involving the handling of large volumes of solution. We are probably the first to grow this fungus on semi-solid media like those tried by Oshima and Church[4] with a view to study the development of anti-bacterial activity. We found that the maximum anti-staphylococcus aureus activity was reached within 3 days. The activity of the nutrient medium after 3 days' growth diluted ten times with distilled water and sterilized by filtering through L 3 candle was found to be 3 to 4 'Oxford Units'. This activity of the metabolic solution is the same as that reported by Florey and Jenning[5] and we have verified this by growing the fungus in Czapek-Dox media for 12 days at 24° C.

Another point observed by us is that though the antibacterial activity reaches its maximum in 3 days, the production of the dye chrysogenin[6] is at this stage very little. One more point of importance is that the anti-bacterial potency of the nutrient semi-solid media did not come down very much even after storing it at room temperature for a period of 3 weeks.

Department of Biochemistry,
Indian Institute of Science,
Bangalore, S. SRINIVASA RAO.
June 10, 1943. S. P. DE.

1 Abraham, Chain, *et al.*, *Lancet*, 1941, **241**, 177 2. Hobby, *et al.*, *Proc. Soc. Exp. Biol. & Med.*, 1942, **50**, 277. 3. Challinor, *Nature*, 1942, **150**, 688. 4. Oshima and Church, *Ind. Eng. Chem.*, 1923, **15**, 67. 5. Florey and Jenning, *Brit. J. Exp. Path.*, 1942, **23**, 120. 6. Clutterbuck, Lovall & Raistrick, *Biochem. J.*, 1932, **26**, 1907.

REVIEWS

Prism and Lens Making: A Text-Book for Optical Glass Workers. By F. Twynman. (Adam Hilger, Ltd., London), 1942. Pp. 178. Figs. 63. Price 15 *sh.* (postage 5*d.* extra).

Optical manufacture is a highly specialised industry, the success of which depends on the combination of a thorough knowledge of optical principles and the development of carefully worked out processes for the selection of raw materials and for the grinding, polishing, figuring and testing of the desired products. No authoritative book exists so far giving working details of the industry, as the few optical firms who hold the world monopoly, carefully guard their methods as 'trade secrets'. The publication of the book under review by the Managing Director of the reputed optical manufacturers of Great Britain, should, therefore, be considered as a blessing by instrument technologists and students of optics alike. The book is divided into eleven chapters. After a brief historical introduction in chapter I, the author deals with the elements of single lens grinding in Chapter II. Chapter III gives a suggestive summary of the physical nature of grinding and polishing. The working details of trueing tools, measuring instruments, abrasives, and polishers are given in Chapter IV. The technique and machinery connected with the mass production of lenses and prisms are described in Chapter V. Chapters VI and VII deal with the finishing and balsaming of lenses and prisms singly and in batches, and Chapter VIII gives the essential details of equipment and the methods employed for testing of the finished products. The last two chapters touch upon the manufacture of microscope objectives and the testing of optical glass respectively. In four appendices, much useful information is collected together on light sources, reflecting surfaces, physical properties of glass, pitch, etc., and technical terms used in manufacture. The book is well-illustrated by diagrams and photographs.

The success in the production of optical instruments depends solely on the skill of the individual workman and it is a matter of deep gratification to notice that the author has given unreservedly the minutest details of the prevailing practices in the Hilger Optical Workshop. Difficulties in working, which are several, are specially mentioned in appropriate places and the remedies are suggested. The claim put forward by the author in the Preface that 'these methods and machines will enable even an unskilled workman, after a short period of training under competent supervision, to produce work of first quality' is none too exaggerated.

The volume would, however, have a wider appeal if it includes a few more chapters on the production of (1) optical flats and plane parallel plates, *e.g.*, Lummer plates, (2) telescope lenses and mirrors, and (3) prisms and lenses with materials other than glass or quartz, *e.g.*, calcite, rocksalt and fluorite.

The book will be received with special interest in India. Some preliminary attempts have already been made for the manufacture of optical instruments by Dr. H. Parameswaran and his co-workers. The publication of the present book by Prof. Twyman should give further stimulus to the advancement of optical industry in India.

C. S. Venkateswaran.

Radio Receiver Design—Part I. Radio Frequency Amplification and Detection. By K. R. Sturley. (Chapman and Hall, Ltd., London), 1943. Pp. 435. Price 28*sh.* net.

The present work by Dr. Sturley of the Marconi School of Wireless Communication contributes an important volume to the fairly wide list of text-books on Radio Engineering. However it confines itself exclusively to the detailed considerations of the principles involved in the field of modern receiver design which are rather cursorily dealt with in general texts. As such, a lot of new material has been brought together on the subject for which previously recourse had to be taken to various wireless journals.

The volume under review forms Part I of the projected two parts and is divided into eight chapters. The order of treatment is reverse of that found in the usual books on Radio Engineering. This has been rather inevitable due to the choice of the subject-matter where the treatment is made to follow step by step the design procedure of receivers. Thus the first two chapters on general considerations and valves are followed by detailed chapters on receiving aerials and aerial coupling circuits, radio-frequency amplification, frequency conversion, oscillators for superheterodyne reception, intermediate frequency amplification and detection in the order mentioned. "Part II will deal with audio-frequency amplification, power supplies, receiver measurements, television and frequency modulated receiver design, etc." Possible criticism against the adoption of such a method of treatment may be advanced from purely pedagogical point of view; for instance, considerations on LC circuits and coupled circuits are given piecemeal in their applications in three separate chapters instead of a unified treatment of the same at one place. Nevertheless it can be said that it has served here to bring out the essential differences in the design features in each case.

Besides the descriptions of various types of receiving aerials such as the Vertical, Inverted L-type, T-aerial, the Dipole and the Frame aerial, and their terminal impedances, Chapter 3 gives generalized formulæ for transfer voltage, selectivity and mistune ratios and capacitance correction over the tuning range. Chapter 4 on r.f. amplification includes discussion on design principles for shortwave and ultra-shortwave amplification. About sixty pages of the text, comprising Chapter 5, are devoted to frequency changing where a

thorough treatment of this aspect of the design is given, both analytically and graphically. Special valves developed for this purpose—the triode-pentode, triode-hexode, pentnagrid, etc., —and various circuits employing them are described in some detail. Theoretical treatment on conversion conductance and methods of its measurement as well as the problem of image signal interference in all its aspects including construction of interference charts and suppression circuits are described at length. The treatment on oscillators in Chapter 6 is similar to what is generally found elsewhere except that the emphasis is on those designed for heterodyne reception. A useful feature of this chapter is the discussion on ganging problem showing a graphical construction for the determination of the padding and trimming capacitances; approximate expressions for ganged oscillator circuit components for different intermediate frequencies are also derived. The important features of Chapter 7 on i.f. amplification are the design of i.f. transformers, generalised selectivity curves for mutual inductance coupling and for cathode feedback. The final chapter on detection describes the main three types of detectors, *viz.*, diode type, cumulative grid and power grid types and anode bend type.

Analytical methods are freely used everywhere in the book and there are hardly a few pages where there is not any algebra or curves showing the analytical relationship of circuit parameters. Two small appendices at the end are usefully devoted to complex notation and Fourier Series method as applied to Radio Engineering problems. At the end of each chapter is given a bibliography of appropriate references to various wireless journals.

The only complaint that the reviewer feels obliged to make is that the author in giving an idea of atomic structure in the chapter on valves has based his statements on the old theory of the nucleus. For a book published in 1943 the atomic weight does not equal the gross positive charge on the nucleus for the latter has no electrons inside it—not even for a book on receiver design.

A minor slip in algebra occurs on page 37. Equation 2·5 *e* where $E_0 = I_m E_{ik} Z_0$ should be read instead of $E_0 = I_m E_{ik}$.

The book is to be heartily recommended to all those interested in Radio Engineering; the students and teachers alike will find it an important addition to their books for study and reference. It is indispensable to those whose interests lie in the field of modern receiver design.

N. B. BHATT.

Elementary Physical Chemistry. By Merle Randall and Leon Eether Young. (Randall and Sons, 2512, Etna Street, Birkeley, California), 1942. Pp. xiv + 455. Price $4.50.

One of the principal defects of the older methods of teaching Physical Chemistry has been to treat the subject as a distinct branch of Chemistry, isolated from other branches, so that its value in practical applications was not fully appreciated. This unfortunate circumstance is overcome in this new text-book, where the older abstruse handling of the subject is eminently replaced by one that treats Physical Chemistry as the very basis, or as the grammar, of the whole of Chemistry. This is achieved largely through the application of the practical experiments performed by students in the elementary organic and analytical laboratories to establish the fundamental physico-chemical principles. The laws of Physical Chemistry are no longer set in verbose enunciations, but are explained with practical illustrations and examples. The practical inseparability of Physical Chemistry from any other branch of Chemistry is thus emphasised most satisfactorily.

The arrangement of material is more stimulating to the student than the traditional order, in that the more immediate applications to his every-day experience are presented earlier in the book. In the opening chapter, a brief account of the modern concept of Chemistry is given. The succeeding chapters deal with the most familiar case of change of state, *viz.*, the vaporisation of liquids and solids. Then follow a few introductory chapters on the properties of electrolytes, with a view to bring out the principles of acid-base titrations. The elementary principles of thermodynamics are introduced in small doses from the very beginning, so that when the subject is elaborated in the latter part of the book the student finds it void of the usual hyper-mathematical presentation and appreciates fully its value in practical applications. The more advanced treatment of electro-chemistry is taken up only after the chapters devoted exclusively to Thermodynamics. Of particular interest to students of Chemical Engineering is a chapter on Flow of Fluids. Numerous references to original papers and more advanced treatises of Physico-chemical subjects have been included in this work.

The book is by no means elementary in treatment, for it has something to say on practically every aspect of Physical Chemistry. The matter is too highly compressed into a small volume to appeal to the junior student. It can, however, be recommended to the teacher, who can advantageously adopt the newer methods of teaching and can also draw upon the numerous practical illustrations, exercises and references given in the book. The work can aptly be described as a broad, if not ambitious, survey of modernized classical physical chemistry, which would enable those who have already studied the subject to appreciate the practical worth of their learning.

M. V. C. SASTRI.

Indian Mining: A Concise Handbook for Laymen and Specialists. By J. A. Dunn. (The Mining, Geological and Metallurgical Institute of India, Calcutta), 1943. Pp. xi + 262. Price Rs. 10, postage extra; Rs. 5 for members of the Institute.

In India, as in most countries, the vast and growing mineral industry forms the foundation of all other industries. Much of this is of a highly technical nature, and many of its workers are necessarily specialists along certain limited channels. The object of this book is to supply a general picture of this industry as a whole, so as to be at once useful to the layman and the several specialists in the different aspects of this vast subject. Therefore,

while the basic fundamentals are clearly outlined throughout, technical details have been restricted to a minimum, as they can and must be supplemented by experienced specialists. Chapters II and III give a broad picture of the distribution and mode of occurrence of minerals in nature. Chapters IV to XV outline the various phases of prospecting, sampling, methods of estimating and grading of minerals, estimation of reserves, mining and costs, and treatment of minerals and their marketing. Chapters XVI to XVIII explain how a mine is evaluated with reference to the several variables involved such as labour, transport, and marketing trends, and how an invester can estimate the relative value of mining shares. Chapters XIX to XXIII are concerned with various legislative aspects such as mining concessions, Acts, Taxes and Tariffs, etc.

Particular emphasis is laid in the Preface on the great utility of this book to laymen including officials who are interested in administration and those "hard-working folk" who are interested in mineral matters, trying "to earn a good living from innumerable small deposits scattered up and down the length and breadth of the country"; and also, to the large body of people interested in mining shares which are considered in general as risky speculations.

Although the book is seemingly stressing the financial aspects of mining industry, it is replete with useful informations to the industrial chemists, particularly in the chapters on Tests and Grading of the Indian Minerals, the different local mining costs, the respective treatments for these minerals, the conditions for Indian and foreign marketing, and costs. The book will thus be also useful as a valuable reference book in many chemical and industrial laboratories. It is besides very neatly got up and does great credit to the printers and publishers. Priced somewhat high, at Rs. 10, the entire profits from the sales will be contributed to an Indian War Fund.

Museum Method and the Process of Cleaning and Preservation. By Minendra Nath Basu. (Calcutta University); 1943. Pp. iv + 34.

"Unless there is a change in the near future, proof of India's cultural greatness in terms of handicrafts will disappear before our eyes and the historian of the future will have to go to Europe for evidence that centuries ago, India could weave, carve, compose and create superb objects of art and industry. Consideration of what should be done by the authorities in India to preserve for posterity her priceless treasures can no longer be postponed." So wrote Messrs. Hargreaves and Markham who reviewed museum work in India in 1936. The present handbook—the first of its kind in India—written by Mr. Minendra Nath Basu, M.Sc., P.R.S., and published by the Calcutta University, is intended to fill the gap and impart knowledge and training in the art of preserving museum exhibits. The author has shown initiative and enthusiasm in the choice and handling of topics. The Calcutta University may well be congratulated for taking this subject within its purview.

In the preface the author rightly complains that no work has been done on the control of humidity in the art galleries of Bengal, where problems of humidity are of great importance. Some work has, no doubt, been done on such problems for other climates in Europe and America. Unfortunately Indian museums and art galleries have not at hand the necessary resources in men and money and one can only hope that the University of Calcutta with all its resources would cope with this work.

The booklet deals with the cleaning and preservation of organic materials, pictures and paintings, foodstuffs and leaves, siliceous materials and metals. The subject of cleaning and preservation of museum exhibits is a new one in many countries in Europe and America, and it is more so in India. Exhibits are of various materials in varying stages of decay and discovered under very different conditions. Hence their cleaning and preservation become a complex subject and no generally uniform procedure can be recommended. Environmental conditions and destructive forces must be studied for each before any treatment. The author recommends the treatment of corroded copper alloys with ammonium chloride, stannous chloride and hydrochloric acid. At best this can be applied to mild cases of corrosion where there is abundance of metal. Evidently the author found the method a success in such cases. But if the metal is, however, porous, the chlorides might get lodged in the pores of the metal and give rise to 'bronze disease' and to eventual destruction of the alloy. Owing to this risk, the method is seldom followed to-day. Again he recommends that fabrics should be soaked in benzene and petrol for removing oil and grease stains or treated with alkalies. This is, no doubt, a good method for fabrics in a good state of preservation. But such a treatment hastens decay in the case of old fabrics. The author suggests the use of water for cleaning tempera, but advocates caution in its use for cleaning paintings on plaster. It is well known that certain classes of paintings on plaster such as the *fresco* do stand even rough cleaning with water. Generally the reader does not get a clear account of the conditions under which the author has worked, the nature of the objects actually treated by him, and the stability of the results attained. One interesting feature of the handbook is the suggestion for the use of a number of indigenous preparations such as potato and onion juice for cleaning paintings, green mangosteen extracts for strengthening fragile objects, chopped tobacco leaves and pepper as insecticides. In dealing with valuable antiquities, no method should be employed unless it is supported by successful experience and then the reader would have welcomed more experimental data on the subject.

S. P. S.

HOW FAST WILL MAN TRAVEL?

BODY LAGS FAR BEHIND MACHINE IN ABILITY TO TRAVEL AT SPEED

SCIENTISTS, hoping to step up flying speeds from the 500 miles-per-hour mark to within range of 1,000 m.p.h., are worrying more about man's physical constitution than they are about such things as wind resistance, stream-lining, engine-power, lift, acceleration and the host of mechanical factors which have to be reckoned with. For them, the probable behaviour of the blood is harder to estimate than the behaviour of assemblies of mental hurtled through the air at higher and higher speeds.

At the moment, really high speeds have been attained only in exceptional circumstances. For example, in a power dive (in which an American military plane has reached 650 miles per hour) or in a fast combat turn, the top speed is attained suddenly, within a few seconds of the lower speed. And the inability of the human body to face sudden accelerations of this intensity is the main obstacle to research in this sphere.

It is the actual acceleration itself, and not the very high speed, which causes the trouble. Experts are confident that any person of average sound constitution can smile comfortably through an acceleration in level flight of 30 metres per second, right up to 1,000 m.p.h. (1,610 km. per hour) in 15 seconds, and would feel no ill-effects afterwards. But even if peace-time should follow up military experience with 1,000 m.p.h. stratoplanes, no airborne machine which reaches such speeds can hope to keep all its accelerations to level flight. That is why scientific preoccupation in aeronautics is with tests on pilots after close turns at speed and after pulling out of power dives.

Different physical reactions occur according to the direction of the acceleration, the amount of acceleration, and the time it lasts. The scientific conclusion is that the position of the pilot's body may eventually decide his ability to withstand acceleration strain. For normal purposes the ordinary sitting posture is satisfactory. But the centrifugal force exerted at combat speeds drives blood from the head, concentrates it round the heart. The inturruption of the circulation which occurs reduces the brain's supply of oxygen, impairs the vision and rapidly produces what pilots call "blackout". If acceleration continues, "blackout" changes to complete loss of consciousness, lasting several seconds. Consciousness is regained and vision restored rapidly after acceleration ceases.

In theory, a method of minimising ill-effects would be to support the body in a dense fluid contained in a sealed rigid tank. The U.S.A., whose researches into air speeds and altitudes have given the world some remarkable new devices, have recently internationally patented just such a flying suit: a double-walled suit which can be filled with air, or liquid, under pressure. But improvements in body resistance have also been effected by bandaging the legs and stomach, and by lowering the seat, raising the legs and adopting a crouching position. Greatest improvement, however, has resulted when the pilot is in the prone position. Turns and dives bring centrifugal forces to bear at right angles to the blood stream, in this position, and there is less abrupt displacement of blood. Much greater accelerations can be endured lying prone—face downwards, or upwards,—than in any other known position.

The Germans have produced a Heinkel plane which can reach 400 m.p.h. The British hold the world's land-speed record over a long course, when a Spitfire averaged 408·75 m.p.h. for 200 miles. The American "Thunderbolt" is the most powerful single-seat fighter in the world, and has easily topped the 400-m.p.h. mark. But all these planes carry heavy arms, ammunition, fuel, wind-resisting radio aerials and all the necessary equipment demanded by combat conditions. And so powerful have the engines which lift and accelerate these loads become, that when peace-time aviation comes back into its own, record speed levels will undoubtedly jump suddenly. Science cannot yet guarantee, however, that man's body will be able to withstand the stresses and strains which the metals that enclose him can easily resist.

Imagineering.—This is a fascinating word coined by the Aluminium Company of America. This new word admirably describes what is constantly taking place in scientific progress, writes *The Journal of Scientific Instruments*, 1942, p. 192. It seems to be especially applicable to the applications of physics to industry. Physicists in these times have usually to be also part-engineers. It has often been pointed out that physics is a subject requiring a good deal of imagination, and as was recently stated in *Nature*, the research physicist's 'real affinity is with the creative artist and the value to the community lies in the spark of originality which he brings with him into the world'. It is this combination of the creative artist with the more mundane engineer that seems to be so beautifully described as an 'imagineer'. It is to be hoped that imagineering which has come so much to the fore in recent years will develop under that name or any other that proves equally convenient and expressive.

SCIENCE NOTES AND NEWS

Fruit Flies of Poona.—Messrs. K. N. Trehan and S. V. Pingle from Agricultural College, Poona, write:—

Of the species of fruit flies recorded by us at Poona, *Dacus ferrugineus* F., *Dacus ferrugineus dorsalis* Hend., *Dacus zonatus* Saund., *Dacus cucurbitæ* Coq., and *Carpomia vesuviana* A.C., are responsible for considerable amount of damage; whereas *Dacus correctus* B., *Dacus diversus* Coq., *Mellesis* sp., and *Zeugodacus caudatus* are of minor importance since they do not cause any appreciable damage.

The following alternative host plants have been recorded by us for each species:—

I. *Dacus ferrugineus* F., bred from Mango (*Mangifera indica*), Guava (*Psidium guyava* L.), Citrus sp. Banana* (*Musa safrientum* L.), and Tomatoes (*Solanum lycopersicum* L.).

II. *Dacus ferrugineus dorsalis* Hend., bred from Mango, Guava and Tomatoes.

III. *Dacus zonatus*, bred from Mango, Guava, Chikoo (*Achrus sapota* L.), Tondli (*Cociinia indica* W. & A.), and water melon (*Citrullus vulgaris*).

IV. *Dacus cucurbitæ* Coq., bred from water melon, Khira (*Cucumis sativus* L.), snake gourd (*Trichosanthes anguina* L.), Dudhia (*Lagenaria vulgaris* Sc.), Ghosali (*Luffa ægyptiaca* Mill), Bitter gourd (*Momordica charantia* L.), Tomatoes and Tondli.

V. *Dacus correctus* B., bred from chikoo, citrus sp., Guava and Mango.

VI. *Carpomyia vesuviana* A.C., from Ber (*Ziziphus jujuba*).

The following is the relative investation of different species on one and the same fruit:—

	per cent.
1. Mango (*Mangifera indica* L.)	
(*i*) *Dacus ferrugineus* F. ..	52
(*ii*) *D. zonatus* S. ..	31
(*iii*) *D. correctus* B. ..	9
(*iv*) *D. ferrugineus dorsalis* H. ..	7
2. Guava (*Psidium guayava* L.)	
(*i*) *Dacus ferrugineus* F. ..	59
(*ii*) *D. zonatus* S. ..	28
(*iii*) *D. ferrugineus dorsalis* H. ..	12
3. Tondli (*Coccinia indica* W.A.)	
(*i*) *Dacus cucurbitæ* Coq. ..	25
(*ii*) *D. zonatus* S. ..	75

New Paper Fabric.—A significant aspect of the wartime search for substitutes is the use of paper to replace priority materials. One of the most interesting papers yet developed is Aqualized paper, a product of Brown Company, which may be used as a substitute for cloth and burlap. The name "Aqualized" was suggested by the paper's strength when wet, a feature not found in ordinary papers, which tend to lose strength and disintegrate in contact with water. By means of an exclusive process the individual cellulose fibres in the paper are effectively interlocked and fastened, giving an inherent wet strength all the way through the sheet that is independent of any coating or sizing on the surface of the paper. Some types of Aqualized paper are highly absorbent while others are made to repel water.

It is known that the Germans have already utilized paper for clothing, pup tents, sandbags, and camouflage. Aqualized paper, with its high wet strength, lends itself to this type of use and is already being impregnated or coated by converters for many war applications. Aqualized paper also fills an important place in the food field where its uses include potato bags, crate liners, loin wraps, and locker bags for frozen foods.—(*J. Applied Physics*, 1942, p. 788.)

The All-India Manufacturers' Organization.—Sir M. Visvesvaraya, President, and other members of the Working Committee of the All-India Manufacturers' Organisation, met Mr. M. S. A. Hydari, Secretary, Industries and Civil Supplies Department, Government of India, at the Office of the A.I.M.O. The Committee discussed with Mr. Hydari the following subjects:—

(1) Government's policy towards heavy and key industries to be established after the war and the preparation of plans for encouraging such developments.

(2) To extent of encouragement and active assistance Government were prepared to give now and in future to such industries and enterprises.

(3) The Committee wanted to know the post-war reconstruction plans of the Government with a view to co-ordinating its future programme with the plans of Government.

(4) The Committee sought information regarding the industries which had been started in the country since the commencement of the present war and the progress these industries had made. The Committee emphasised the need for Government to announce what protective measures they were prepared to take with a view to assisting the newly started industries.

(5) The Committee impressed upon the Government the necessity of correct compilation of essential statistics with a view to providing a proper standard for measuring the country's industrial progress and future possibilities.

This was followed by a discussion during which Mr. Hydari showed keen interest in the subjects under discussion and gave a sympathetic hearing to the suggestions made by the Committee.

A Mineral Research Institute.—In India, excellent research institutes have been founded to assist various industries such as agriculture, forestry, and jute. It is indeed paradoxical that India's mineral industry,

* First record of the fruit being invested with this pest.

which forms the real foundation for the country's industrial expansion, should have received no assistance of this nature. The scope for a Mineral Research Institute, controlled by practical men of experience, is enormous. Such an Institute would investigate many lines of enquiry, and would also help to co-ordinate the various problems of different branches of the industry. Improvements in treatment of one kind of mineral are commonly related to improvements in treatment of another. For this reason it would be preferable to include the Fuel Research Station, which has so long been advocated, within the Mineral Research Institute. Such an Institute would include also a Bureau of Mineral Information which would serve as a centre for the dissemination of information regarding minerals, and would issue statistics and bulletins; it would have a permanent staff whose duty it would be to make a study of Indian economic mineral resources. The Institute would be in close co-operation both with industry in general and with Government; its success would be largely dependent on the selection of its administrative staff from technical men of experience who must be left to work without political or official interference."
—(Extract from *Indian Mining*, by J. A. Dunn, 1943, p. 244, and reviewed on p. 211.)

Element No. 85.—*Science* (1943, 97, 112) reports press despatches from Bern, Switzerland, regarding the identification of element 85 as a disintegration product of radium. The work was done by Dr. Walter Minder and Dr. Alice Leigh-Smith, at the Radium Institute. They have collected sufficient amount and have succeeded in the photographic identification of the element. The name Anglo-helvetium is proposed in honour of England and Switzerland.

Central Jute Committee Monsoon Meeting: Important University Schemes.—The search for a suitable specification for a blue-dyed and polished jute twine to replace Italian hemp, for wool packs, in response to an enquiry from S. Africa, is engaging the attention of the Indian Central Jute Committee. This was revealed at the Monsoon meeting of the Committee held on July 15, under the presidency of Dr. W. Burns, C.I.E., acting Vice-Chairman of the Imperial Council of Agricultural Research. The problem of meeting the present shortage of steel hoops for binding cotton bales by finding the right type of jute ropes, in addition to the above, amongst others, has also been under investigation.

University schemes for (1) impregnating bleached jute fibre with a view to improving its textile qualities, (2) investigations on the chemical utilisation of jute waste and (3) X-Ray analysis of jute fibre with the particular view of exploring the possibilities of dyeing jute, by Profs. J. K. Chowdhury, B. C. Guha and M. N. Saha, respectively, were decided to be continued.

Prof. B. C. Kundu's scheme for the microscopic study of the growth and development of the jute fibre and Prof. B. C. Guha's scheme to study the micro-biology of retting were also decided to be continued.

A new scheme submitted by Prof. Sen Gupta of the Presidency College, Calcutta, for studying the effect of temperature, light and mineral nutrition on the growth of the jute plant was accepted in principle.

The Committee sanctioned a Jute Inspector to assist the Bengal Department of Agriculture for supervision of the Jute Propaganda Staff. Three additional posts of Agricultural Demonstrators were created to strengthen the jute propaganda work in Assam. An Orissa scheme for the multiplication of improved jute seed was sanctioned.

An important information revealed at the meeting was that while substitutes for jute were being developed during the war in many countries, U.S.A. topping the list, new uses for jute were being investigated in India alone.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory, Bombay, during the month of June 1943, there were four slight, two of moderate and two of great intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin I.S.T.	Epicentral distance from Bombay	Co-ordinates of epicentre (tentative)	Depth of focus
		H. M.	(Miles)		(Miles)
2	Slight	09 25	1410		..
8	Moderate	05 50	2610	Lat. 2°·0 N., Long. 107°·5E.,	.. ..
9	Great	03 13	2570	Lat. 1°·5 N., Long. 107°·5E.,	.. ..
9	Great	09 36	2410	Lat. 2°·5 N., Long 105°·5 E.	75
13	Moderate	11 41	4590	..	..
15	Slight	17 40	4540	..	..
20*	Slight	22 03	2910	..	..
29	Slight	15 35	3730	..	95

* Extensive damage in the Turkish town of Adapazar has been reported. Sivas in Anatolia and the districts of Hendek and Arifiye have also been seriously affected.

MAGNETIC NOTES

Magnetic conditions during June 1943 were slightly more disturbed than in the previous month. There were 10 *quiet* days and 20 days of *slight* disturbance as against 20 quiet days and 10 days of slight disturbance during June 1942.

The quietest day during June 1943 was the 15th and the day of largest disturbance was the 8th.

The individual days during the month were classified as shown below.

Quiet days	Disturbed days
	Slight
1-5, 15-18, 30	6-14, 19-29

No magnetic storms occurred during the month of June in the years 1942 and 1943.

The mean character figure for the month of June 1943 was 0·67 as against 0·33 for June of last year.

M. V. SIVARAMAKRISHNAN.

ANNOUNCEMENTS

DR. P. K. KELKAR, M.A., PH.D., Lecturer in the Department of Electrical Technology, Indian Institute of Science, has been appointed Head of the Department of Electrical Engineering, V.J.T. Institute (Central Technical Institute), Bombay.

Art in Industry Exhibition.—It is announced that the 1944 Art in Industry Exhibition will be held in Calcutta in January of next year. Prize money will exceed Rs. 20,000 which is a record for any art exhibition in India. The Exhibition will contain a number of sections devoted to posters of recruiting themes and defence savings, and careless talk publicity will also feature prominently in the Exhibition. New features will be sections devoted to film scenarios, commercial photography and industrial design. Further announcements will be made shortly.

We acknowledge with thanks the receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 91, Nos. 4635, 4636 and 4639.

"Allahabad Farmer," Vol. 17, No. 3.

"Journal of the Indian Chemical Society," Vol. 20, No. 5.

"Indian Farming," Vol. 4, No. 2.

"Transactions of the Faraday Society," Vol. 39, Nos. 4 and 5.

"Indian Forester," Vol. 69, Nos. 5-7.

"Horticultural Abstracts," Vol. 13, No. 1.

"Central Board of Irrigation Bulletin," No. 38 (June 1943).

"Bulletin of the Central Jute Committee," Vol. 6, No. 3.

"The Journal of the Indian Mathematical Society," Vol. 6, No. 4.

"The Mathematics Student," Vol. 10, No. 3.

"Indian Medical Gazette," Vol. 78, No. 6.

"Bulletin of the American Meteorological Society," Vol. 23, No. 8.

"The Journal of the Bombay Natural History Society," Vol. 43, No. 4.

"Nature," Vol. 151, Nos. 3822, 3824-26.

"Journal of Nutrition," Vol. 25, No. 2.

"American Museum of Natural History," Vol. 50, No. 5; and Vol. 51, No. 3.

"Indian Journal of Physics," Vol. 16, Pt. 6; Vol. 17, Pt. 1.

"Science," Vol. 96, Nos. 2499, 2501 and 2503.

"Science and Culture," Vol. 8, Nos. 11 and 12; and Vol. 9, No. 1.

"Journal of Scientific and Industrial Research," Vol. 1, No. 3.

"Monthly Science News," Nos. 17-20.

"Sky," Vol. 2, Nos. 2, 4 and 5.

"Indian Trade Journal," Vol. 149, Nos. 1928-31; and Vol. 150, No. 1932.

"The Indian Journal of Veterinary Science and Animal Husbandry," Vol. 13, Pt. 1.

BOOKS

Soil and Plant Analysis. By C. S. Piper. (The University of Adelaide, Adelaide, South Australia), 1942. Pp. xiv + 368. Price 15/- (Australian Currency).

The Ultracentrifuge. By Wilbur G. Valentine. (New York Academy of Sciences, New York, U.S.A.), 1942. Pp. 175-251.

Museum Method and the Process of Cleaning and Preservation. By Minendra Nath Basu. (Bhupendralal Banerji, Esq., Calcutta University Press, Calcutta), 1943. Pp. iv + 34.

The Technique of Radio Design. By E. E. Zeppler. (Chapman and Hall, Ltd., London), 1943. Pp. xii + 311. Price 21*sh.*

Indian Mining. (A Concise Handbook for Layman and Specialists). By J. A. Dunn. (Mining, Geological and Metallurgical Institute of India, Calcutta), 1943. Pp. xii + 262. Price Rs. 10, postage extra.

Geology of India and Burma. By M. S. Krishnan. (Madras Law Journal Office, Madras), 1943. Pp. xvi + 518. Price Rs. 15, postage extra.

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CURRENT SCIENCE

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THE UNITED NATIONS CONFERENCE ON FOOD AND AGRICULTURE

THE Conference sat in Hot Springs, Virginia, U.S.A., from May 18th to June 4th, 1943, and was attended by the delegates of forty-four nations. The Chairman of the delegation from India was Sir Girja Shankar Bajpai, Agent-General for India in the United States; the other members were Sir Pheroze Kharegat, Vice-Chairman, Imperial Council of Agricultural Research, Sir David Meek, Trade Commissioner, London, Mr. H. S. Malik, Trade Commissioner, New York, and the writer of this article.

The Agenda

By its terms of reference, the Conference was mainly concerned with post-war problems and with general principles. It was exploratory, fact-finding and technical rather than political. At the outset the objectives of the Conference were not fully understood by the American press and there was a general impression that immediate and urgent food problems arising out of the war were the main subject for discussion. The question of food supplies to meet the needs of occupied countries after their liberation is, however, being dealt with by another United Nations organisation directly concerned with relief. The supply of food under Lease-Lend is also a separate question. The Food Conference was essentially an attempt to consider basic problems of nutrition, food and agriculture in a world freed from aggression and ready to set out once more on the path of progress.

The main items on the agenda were as follows:—

(1) Consumption levels and requirements:
   (*a*) Food.
   (*b*) Other essential agricultural products.

(2) Expansion of production and adaptation to consumption needs.

(3) Facilitation and improvement of distribution.

(4) Recommendations for continuing and carrying forward the work of the Conference.

Consumption

The first task was to study existing consumption levels in various parts of the world and to ascertain how far these conform to a reasonable standard of living. It was from the start recognised that in the great majority of countries the consumption of food is inadequate in the sense that the diets of large sections of the population fall below the standards recommended by nutrition workers. As the Conference Report puts it: "Each country is faced with problems of under-consumption and malnutrition, problems which differ in severity in different regions but which, in general, are everywhere the same." From this conception it follows that any accumulations of unmarketable food products which have occurred in the past were not real "surpluses" in relation to world needs; they were in fact the result of mal-distribution and went hand in hand with gross under-consumption. "There has never been", the Conference declared, "enough food for the health of all people. This is justified neither by ignorance nor by the harshness of nature".

More food, then, is needed, and it can be produced. The Conference made a detailed study of measures for increasing agricultural production and for organising it on a world basis. It considered the relation of national and international economic policies to agricultural problems with special reference to the

distribution of agricultural products. The question of buffer stocks and commodity arrangements to ensure equitable prices and adequate supplies was discussed. It would be impossible, within the scope of this article, to give even a brief resumé of the findings and recommendations on questions of this nature and numerous other subjects of equal importance. Those interested should study the report itself, a document of some 61 pages. Here it is proposed to consider in greater detail the sections of the report which deal specifically with problems of nutrition.

THE LEAGUE OF NATIONS AND NUTRITION

In this particular sphere the Food Conference was building on foundations already laid by the League of Nations. It will be recalled that the League Assembly in 1935 was impressed by the slogan "Marry health and agriculture". From that year until the outbreak of the war the League carried out valuable work on nutrition on an international scale. The Final Report of the Mixed Committee of the League of Nations on "The Relation of Nutrition to Health, Agriculture and Economic Policy" is an admirable document including many ideas which influenced the United Nations Food Conference. The League's work was, however, largely confined to Europe, North America and the British Dominions. A beginning was made to develop work in the East at the Bandoeng Conference in 1937, but the war intervened before much progress could be made. The Conference had at its disposal the Report "Nutrition in the Colonial Empire", which contains much detailed information about the extent of malnutrition in various parts of the world, notably tropical Africa. Reports on nutrition in China, India, the Netherlands East Indies, the Philippines, Egypt, Mexico and various South American countries were presented by delegates. The Conference was, therefore, in a position to make a wider survey than had been possible to the League. It had plenty of data on which to base its conclusion that "in the world as a whole, the picture is one of world-wide underconsumption, leading to malnutrition and its attendant evils".

FOOD AND HEALTH

Strong statements were made on the subject of nutrition and health. "Malnutrition ... is the close and constant companion of poverty, both national and individual. Poverty almost invariably means a poor and insufficient diet and the latter is the main cause of the disadvantage of the poor in respect of health, so clearly shown by statistics of disease and mortality". It was suggested that the high infant and childhood mortality in many countries, including India, has its roots in malnutrition. Diet deficiency reduces resistance to various kinds of disease, *e.g.*, tuberculosis, and makes convalescence more difficult and prolonged. "There is a close relation between such diseases as hookworm and malaria and malnutrition. In the first place, the economic efficiency of a population in which they are rife is reduced and with it their capacity to produce or purchase an adequate supply of food. Secondly, malnutrition decreases the power of the individual to carry the burden of blood-destroying diseases and impedes his recovery when the burden is decreased or removed by medical treatment. A vicious circle is thus created."

Reference was made to the widespread existence of food deficiency diseases which cause much unnecessary suffering since they are preventable but not prevented. The Conference recommended that a vigorous attack on deficiency diseases should be undertaken. The first step, in many countries, is to ascertain the prevalence of such diseases. The recommendations on this subject are of interest and importance to public health authorities in India.

"On the positive side, there is much evidence of the general improvement of health and physique which can be produced by the improvement of diets and there are also striking examples of the prevention of food deficiency diseases by appropriate measures. Successes already achieved provide abundant hope for the future, but what has already been done is little in comparison with the tasks that lie ahead. ... Good food means good health. It enhances the capacity of human beings to contribute to civilisation and progress and adds to human happiness."

INTERMEDIATE OBJECTIVES

The goal of "a vastly different world fed in full accordance with the nutritional requirements of its population" is a remote one. Visions of a distant and happy future are pleasing, but they must not obscure our view of immediate reality. Various standards of adequate nutrition have been approved by nutrition workers; these recommend the amounts of nutrients or food constituents necessary to ensure for human beings a high level of health and vitality, in so far as this can be ensured by diet. One of these—that put forward by the National Research Council, U.S.A., in 1943—is quoted in the Conference Report and translated from terms of calories, proteins, vitamins, etc., into foods *per capita* per year. The National Research Council standard means essentially a rich and varied diet containing an abundance of milk, meat, eggs, vegetables and fruits and a relatively low proportion of cereals—it is a standard closely resembling that drawn up in 1936 by the Technical Commission on Nutrition of the League of Nations. Now if such a standard be adopted as the immediate goal in a poor and ill-fed country, the gulf between the standard and the existing level of diet is so great that the value of the standard as a guide to national food, agricultural and economic policy is lost. It becomes necessary, therefore, to set up more easily attainable goals for purposes of practical nutrition work. Recommendations for improvement must be so adjusted as to raise the existing level of diets to a degree which is not beyond the bounds of practical possibility and which, at all events, makes it less remote from the "optimum" standard. "With the continued and expanding application of science to the development of the world's food resources, local intermediate goals can be gradually raised in the direction of the ultimate objective."

The first step, in planning nutritional policies, is to estimate the average consumption of the various foods by the population concerned, preferably on a *per capita* basis. The rough data about food intake so obtained should be checked by family diet surveys. The state of nutrition of the population should be investigated by medical and public health workers. In this way the defects in the national diet will be made manifest. The adjustment of agricultural and economic policy to correct the defects follows. When the existing level of diet is a low one, an "intermediate objective" as defined above must be aimed at. Often the first necessity is *enough* food, without much regard for variety and quality. If, however, enough food can be made available, and there is at the same time some degree of variety, qualitative defects in the diet, *e.g.*, in intake of protein, vitamins, etc., will be very considerably reduced.

Typical Eastern and tropical diets are largely composed of vegetable foods and do not contain milk, meat and eggs except in small or negligible quantities. The increased production of the latter may present a problem of formidable difficulty, but there are other foods such as pulses, leafy vegetables, fish and fruit, which may already be familiar and valuable ingredients in the diet. The production of these should materially and rapidly be increased. Food policy should not run counter to the habits and tastes of the population. There are many condiments and beverages consumed by various peoples which are not in themselves of high nutritive value but which may be of importance in that they increase the attractiveness of monotonous diets. Various traditional methods of preparing food may have more virtue than modern nutrition workers suspect. "Nutritional and agricultural policies which ignore traditional methods of 'enlivening' monotonous diets may defeat their own ends. Such methods should usually be regarded with respect. . . . The aim of those whose task it is to secure the improvement of nutrition should be to frame their policies so that they are in tune with and can become part of the social tradition."

The Conference recommended that special attention should be given to improving the diet of "vulnerable" groups, *e.g.*, infants, children, and expectant and nursing mothers. It stressed the importance of education. Various other problems, such as the fraudulent advertising of food preparations and the place of synthetic vitamins in nutrition policy, were also briefly considered.

National Nutrition Organisations

One of the formal recommendations was concerned with the establishment in each country of nutrition committees or organisations which should include authorities on health, nutrition, economics and agriculture, together with administrators and consumers' representatives. In making this recommendation the Conference followed the lead of the League of Nations, which before the war had succeeded in bringing into being national nutrition committees in a number of countries. Some of these did sound and useful work. It was further advocated that the national committees should exchange information and experience and that representatives of the committees should meet regularly "to exchange views and to make proposals for any national and international action necessary to facilitate the progress of their work". It will be one of the tasks of the permanent organisation created by the Conference to arrange such meetings and in general to act as a link between national nutrition committees.

The Immediate Post-War Period

After the war the world will be faced with a general shortage of food, accompanied by and interrelated with shortage of transport, including shipping, and of fertilisers, seeds, agricultural machinery and farming implements. The magnitude of the food shortage will depend on the course of the war and the size of harvests. It is clear that the shortage of animal products will be more serious than that of grain and other vegetable products. In occupied Europe there has been widespread destruction of livestock and it must take some years to restore dairy herds and other food-producing animals. During this period emphasis must be laid on the production of energy-producing foods. This will mean, at any rate, in certain countries, an increase in the acreage under crops for direct human consumption and a delay in the rebuilding of depleted livestock herds—essential though this rebuilding will ultimately be. There must, therefore, be an interval before agriculture can be adjusted so as to ensure the feeding of populations in accordance with the principles of nutrition. During the difficult period of food shortage after the war the necessity of developing long-term agricultural policies designed to raise standards of diet and health must not be overlooked and forgotten.

The Creation of a New International Organisation

One concrete result of the Conference will be the establishment of an international "Food and Agriculture Organisation", which will presumably replace the existing International Institute of Agriculture in Rome, never a very active or successful institution. The new organisation cannot come into being until after the war; meanwhile an "Interim Commission", meeting in Washington, will plan its duties and functions. Sir Girja Shankar Bajpai has been appointed Chairman. The main task of the permanent organisation will be to implement the recommendations of the Conference, some thirty in number. Ultimately the organisation must play a prominent part in directing world policy in the fields of nutrition and agriculture. Its relation to other international organisations (*e.g.*, an international health organisation) which will presumably come into being after the war is a question of great importance requiring careful consideration by the Interim Commission.

Results of the Conference

What exactly did the Food Conference achieve, apart from the creation of a new

international organisation? On the political side, the Conference was of considerable significance. It was the first United Nations Conference dealing with the basic problems of the post-war world. The facts that it was convened by the United States, held on American soil and attended by a delegation from Russia were duly noted by political commentators as indicating the intention of these countries to collaborate with other countries in the international sphere after the war.

The report will be found disappointing by those who expected dramatic results in the shape of trade agreements and commodity arrangements and still more disappointing by those who hoped that immediate steps would be taken at Hot Springs to relieve the present food situation in India. It deals largely with principles and not with the specific problems of any particular country. It is concerned with the future and not with the present. It is in the main a sober and technical document, varying in its subject-matter from dietary standards and deficiency diseases to co-operative movements, agricultural credit and the conservation of water resources. Various aspects of the problem of increasing the production and improving the distribution of food and other commodities were carefully considered and the principles which should guide national and international action were defined. These must carry weight when the war has been won and the opportunity arises for reconstructing world economy on a sound basis. The responsibility of individual governments in raising the nutritional standards of their peoples by following appropriate agricultural and economic policies is stressed throughout the Report. At the same time, there is equally strong emphasis on collective responsibility and international collaboration. Governments which accept the Conference Declaration accept "the obligation to their respective peoples and to one another, henceforth to collaborate in raising levels of nutrition and standards of living of their peoples and to report to one another on the progress achieved".

In the author's opinion, perhaps the main significance of the Conference, apart from the political side, lies in the *attitude of mind* which inspired its deliberations and findings. The extent of poverty and under-consumption throughout the world was fully recognised and the magnitude of the problems to be faced was not minimised. The war has reduced the world's food supply, affected consumption in almost every country, and led to scarcity and famine in countries occupied by the enemy. Nevertheless the whole tone of the report is one of hope in the scientific and orderly development of the world's food resources for the benefit of its population. Scientific research has defined the food requirements of human beings and has shown that most people in the world are under-fed or badly fed. On the other hand, the Report says in effect, the application of science makes abundance of food for all possible, and the economic and political obstacles which impede the enormous potential expansion of production can in the long run be overcome by resolute and concerted action. It is these facts and possibilities which should guide and inspire governmental action, both national and international, and not the political, economic and financial expediencies of the moment. Such ideas are not new; they are familiar enough as the pious reflections of individual writers. What is new is their recognition by a conference of forty-four nations. It is the way that people, and particularly those in authority, *think* about such matters that ultimately decides how the life of the world shall be organised. The battle of the future must be fought out in the realm of thought. It is surely significant that at the first international conference dealing with the world after the war, an essentially scientific approach to the fundamental problem of "freedom from want" was adopted.

In conclusion, some passages from the speech made by President Roosevelt to the delegates after the meeting may be quoted:

"You have been dealing with agriculture, the most basic of all human activities, and with food, the most basic of all human needs. Twice as many people are employed in work on food and agriculture as in work in all other fields combined. And all people have, in the literal sense of the word, a vital interest in food. That a child or adult should get the nourishment necessary for full health is too important a thing to be left to mere chance. You have recognised that society must accept this responsibility. As you stated in your declaration, 'The primary responsibility lies with each nation for seeing that its own people have the food needed for health and life. Steps to this end are for national determination. But each nation can fully achieve its goal only if all work together'. On behalf of the United States I accept this declaration.

"..... You have examined the needs of all countries for food and other agricultural products, both as they will exist in the short-run period of recovery from the devastation of war, and as they will exist over the longer run, when our efforts can be fully devoted to expanding the production of food so that it will be adequate for health the world over. You have surveyed with courage and with realism the magnitude of these problems and have reached unanimous agreement that they can, and must—and will—be solved.

* * *

"..... You have pooled our knowledge of the means of expanding our output, of increasing our agricultural efficiency, and of adjusting agricultural production to consumption needs. In the fields of both production and consumption you have recognized the need for better utilization of the knowledge we now have and for extending still further the boundaries of our knowledge through education and research.

* * *

"... A sound world agricultural programme will depend upon world political security while that security will in turn be greatly strengthened if each country can be assured of the food it needs. Freedom from want and freedom from fear go hand in hand."

W. R. Aykroyd.

August 1943,
Coonoor, S. India.

PROF. J. N. MUKHERJEE, C.B.E., D.Sc., F.R.A.S.B.

WE have great pleasure in announcing that on the occasion of H. M. the King's Birthday this year, Prof. J. N. Mukherjee has been conferred the title of Commander of the British Empire.

Born in Calcutta in 1893, Prof. Mukherjee was educated at the Presidency College, Calcutta, and joined the Calcutta University in 1915 as a Lecturer in Chemistry. He proceeded on deputation to England in 1919 to work in the University of London under Prof. F. G. Donnan, F.R.S., where he made fundamental contributions to colloid chemistry. On returning to Calcutta in 1921, he was appointed Professor of Chemistry in the University. Prof. Mukherjee is well known as the chief exponent of colloid chemistry in India and the work which he has carried out, either alone or with numerous collaborators on the theory of ionic adsorption and his investigations on soil colloids and bentonite suspensions have established his reputation throughout the scientific world as an eminent worker in this field. Prof. Mukherjee was mainly responsible for starting in 1924 the Indian Chemical Society of which he was Honorary Secretary for the first four years. He was elected the President of the Chemical Section of the sixteenth Indian Science Congress held at Madras in 1929. He proceeded to England in 1938 as Leader of the Indian Delegation to the International Conference of Soil Scientists. He is a member of various committees—Imperial Council of Agricultural Research and Central Jute Research Committee—and has taken an active interest in the progress of *Current Science*. In offering our congratulations to him on the recent distinction, we wish him many more years of useful service to science in this country.

DR. S. K. BANERJI, O.B.E., D.Sc.

WE offer our heartiest congratulations to Dr. S. K. Banerji, Superintending Meteorologist, Upper Air Office, New Delhi, on the conferment of the O.B.E. in the latest King's Birthday Honours List. Dr. Banerji has a record of sustained and distinguished scientific work in many branches of Mathematical Physics, Geo-Physics and Meteorology for more than a quarter of a century. After a brilliant career in the Calcutta University, Dr. Banerji worked in the Indian Association for the Cultivation of Science under Sir C. V. Raman and was awarded the D.Sc. degree of the Calcutta University in 1918 for a thesis on "Some problems in diffraction, wave-motion and vibration". He succeeded the late Dr. Ganesh Prasad as the Ghosh Professor of Applied Mathematics. In 1923, Dr. Banerji joined the Indian Meteorological Department as the Director of the Colaba and Alibag Observatories at Bombay. For the next ten years he conducted many fundamental investigations in Seismology, Atmospheric Electricity and Meteorology, contributing several important papers on these subjects. His papers on the Electric Field of thunderstorms and on microseisms associated with storms in Indian Seas are of particular importance. In 1933, Dr. Banerji was transferred to the Headquarters Office at Poona where, in the midst of heavy administrative duties he found time to continue his scientific work. He officiated as Director-General of Observatories several times and was appointed as a Superintending Meteorologist in 1938. He had a large share in bringing about much of the recent expansion and development in the meteorological development. Last year, Dr. Banerji took up the duties of Superintending Meteorologist of the Upper Air Office, New Delhi, in charge of the Upper Air Organisation of the department. We offer our warmest felicitations to Dr. Banerji on his honour and wish him many more years of distinguished service to the cause of science in India.

BRITISH UNIVERSITY PROFESSORS

READERS of *Current Science* will be greatly interested to learn of two important appointments recently made in British Universities. PROF. A. C. CHIBNALL of the Imperial College, London, succeeds Sir Frederick Gowland Hopkins as Professor of Biochemistry in the University of Cambridge. Prof. Chibnall was chiefly concerned in his earlier work with lipoid constituents of plants. Later, he devoted more attention to proteins and other nitrogenous constituents of plants in relation to problems of nitrogen metabolism. More recently he is interesting himself in fundamental problems of protein structure to which he has made important contributions.

In the University College of North Wales, Bangor, on the retirement of Professor J. L. Simonsen, DR. EDWARD DAVID HUGHES succeeds him. Dr. Hughes is noted for his work on the ionization (or "heterolysis") as controlling phase in a large class of substitution and elimination reactions of saturated molecules and ions, the discovery of the rules governing the spatial orientation of substitution (including a demonstration, by the use of radio-halogens, of the invariability of Walden inversion in bimolecular substitution), and the elucidation of circumstances which control the appearance of steric hindrance in substitution processes.—*Nature*, 1943, 151, 610.

THE NEW Rh CONSTITUENT OF HUMAN BLOOD

BY

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(For blood groups see this *Journal*, 1940, 9, No. 11. In the present communication technical terms are explained in square brackets when not explained in the text.)

WHAT IT IS

RECENT work in America has brought to light yet another constituent (in addition to A & B, and M & N) of the human red blood cells, hereafter called r.b.c.: it is the Rh substance (immunologically the *antigen*, genetically the *character* and loosely, unfortunately, the *factor*). It is called Rh because it occurs normally in the r.b.c. of *Macacus rhesus* [the common brown monkey of India]. It has also been found in America in about 85 per cent. of the human beings tested.

HOW HUMAN BEINGS ARE TESTED

Rhesus monkey's washed r.b.c. are injected into a rabbit or guinea-pig. After a suitable course of injections the *serum* [the watery part of the clotted blood] of the animal begins to *agglutinate* [clump] the monkey's r.b.c. when brought into contact with them in a test tube or on a slide. When the action is strong the r.b.c. are *lysed* [broken up]. This is brought about by an anti-Rh hæmagglutinin [a substance clumping r.b.c.: such anti-substances formed as a result of injections are called *antibodies* in a general way: when the r.b.c. are lysed the substance is *lysin*: the animal has been *immunised* against the monkey's r.b.c.]. The serum, in suitable dilutions, also agglutinates the r.b.c. of 85 per cent. of human beings. These human beings are Rh+: the other 15 per cent. are Rh−.

IMPORTANCE IN MEDICINE

An Rh+ father's child conceived by an Rh− mother may come to grief. The fœtus [developing child in the womb] has in his veins his father's blood which acts on the mother as the injected blood acts on the animal. The mother is *iso-immunised* [*iso* because of the same species] and the anti-bodies act deleteriously on the blood of the fœtus causing its death and expulsion or such a damage to its r.b.c. that on birth the child suffers from jaundice and anæmia and more often than not dies.

Ordinarily the fœtal r.b.c. and the maternal r.b.c. do not mix: a membrane keeps them apart. The membrane, apparently, at times leaks. The antibodies in the mother's blood, on the other hand, being in solution pass freely into the fœtal blood at all times.

Fortunately all Rh− mothers of Rh+ fœtuses do not act in this infanticidal manner, at least not in the first pregnancy. The reason is constitutional. Either the leak in the membrane separating the two circulations does not develop or their systems do not react with full vigour.

Further, not all Rh+ fathers beget Rh+ children from Rh− mothers. The reason is genetical. The character Rh(=Rh+) is dominant to the character rh(=Rh−). A homozygous father (genotype RhRh) must beget Rh+ children while a heterozygous father (genotype Rhrh) may or may not.

It may be asked why a fœtus whose blood group is incompatible with his mother's does not suffer the same fate for similar reasons. The fœtus A of a mother B will also *iso*-immunise the mother who will discharge into the fœtal circulation antibodies against the substance A. The reason so far available is that the group specific substances A and B occur well distributed throughout tissues and fluids of the body, while the Rh substance occurs only in the r.b.c. which, thus, are exposed to the full effect of the mother's antibodies.

The Rh− mother having formed in her blood the antibody against Rh+ blood also comes to grief when she is given a transfusion of an otherwise compatible but Rh+ blood. This risk makes the direct matching of the bloods of the donor and the recipient doubly important when the recipient is an expectant mother or a mother in or after labour.

HUMAN BLOOD IS ALSO USED IN TESTING HUMAN BEINGS

When it is known that a mother has given birth to a baby which is suffering from damage to its r.b.c., the mother's blood is taken and serum obtained from it. This serum will also agglutinate the r.b.c. of Rh+ human beings. Not all such sera are satisfactory. The subject is being studied and points to a rather complex structure of the Rh antigen.

IMPORTANCE IN SOCIOLOGY

A well-known worker on the subject has already suggested artificial insemination, from extraneous compatible sources, of Rh− females incompatibly mated with Rh+ males. A consideration of compatibility before marriage is more natural and will probably be demanded. Most people would be compatible. Others could wait for compatible partners.

IMPORTANCE IN FORENSIC MEDICINE

When the technique of the test has been standardised and further observations on the inheritance of the character Rh made, one more aid to the determination of paternity and maternity of children will be provided. Going by what has been said above of an Rh+ father, some Rh+ couples (genotype Rhrh) can have a Rh− child but Rh− couples cannot have a Rh+ child.

IMPORTANCE IN ANTHROPOLOGY

The serologists have given to the anthropologists yet another means of differentiating between races of humanity.

Levine, P., *New York State Journal of Medicine*, 1942, **42**, No. 20, 1928. 2. Boorman, K. E., Dodd, B. E., and Mollison, P. L., *British Medical Journal*, November 1942, **7**, p. 535. 3. Gallagher, F. W., and Jones, L. R., *The Journal of Immunology*, 1943, **46**, No. 1, 9.

THE RÔLE OF PREDATORS IN BIOLOGICAL CONTROL OF INSECT PESTS

By Dr. K. N. TREHAN
(*Professor of Entomology, College of Agriculture, Poona*)

Introductory

UNDER favourable conditions of food and climate, insects multiply freely but their population is regulated automatically by the presence of their enemies or through the intrinsic limitations of the organisms themselves (Thompson, 1939). This view is also supported by Elton (1930) who emphasized that animal population is controlled by natural factors to a position of optimum density. Occasionally, however, some pests attain prominence either when they are transferred to new environments where they flourish unchecked in the absence of enemies, or in their original habitat where they establish relatively more harmonious relations with their surroundings. Under such circumstances, the economic loss is apt to increase in geometrical progression unless a speedy control is adopted. Insecticidal and mechanical methods of control are practicable when speedy control is desired, but their repeated applications always increase the cost of production since a single treatment does not ensure the crop against future attacks. Cultural methods of control have practically limited scope since they involve certain complications with respect to different varieties, date of sowing, number of irrigations and manures, etc. Biological control on the other hand, implies the application of parasites or predators, either introduced from their original home or bred artificially and liberated in the fields. Both these types of beneficial insects flourish in nature in association with the pest which is thereby kept under control. The parasites cause the death of their victims through a slow process, whereas predators destroy them directly by feeding on them. A lot of useful literature on parasites and parasitism is available but the predators on the contrary have received relatively little attention even though their efficacy has been experimentally established in certain cases.

Origin of Predators

Insects are believed to be primarily phytophagous. In nature, therefore, some species of insects must of necessity have been established on one and the same food plant. Hence according to Sweetman (1936) a slight variation in food habits may produce a useful predatory species. Under extreme cases of restricted food however, a keen competition among individuals of one and the same species or of different species is bound to occur and some of the individuals may be forced to develop cannibalistic habits. Such deviations in feeding habits probably resulted in modification of certain useful characters which in the course of further development became functional and permanent. In most cases, however, morphological modifications are confined to the mouth parts and the grasping organs only.

Secondary differentiation in habits is met with among *Syrphid* larvæ which may be phytophagous, carnivorous or seprophagous. Similar differentiation is also noticed among *Coccinellidæ*, with characteristic modifications in the mandibles of carnivorous and herbivorous forms. It may, therefore, be believed that the predatory habit among insects is secondary in origin.

Host-Predator Relationship

The activities of parasites are usually more appreciated than those of the predators whose specificity in the selection of hosts is often doubted. However, Thompson (1928-29) examined this factor critically and emphasized that the predators like the parasites, are equally specific in the choice of their hosts. For instance, *Hyperaspini* is said to feed exclusively on coccids; *Hippodemiini* mostly on aphids and *Microweiscini* destroy *Diaspini* scales. The genera *Rodalia* and *Novius* feed on Icerya whereas *Scymnus, Syrphids* and *Chrysopids* prey upon aphids and white-flies. Some of the Carabids feed mainly on larger *Lepidoptera* and the *Nitidulid-Rhizophagus* feeds on wood-boring coleopterous larvæ. Of the Hemiptera, *Perillus bioculatus* confines its attack on colorado beetle—*Leptinotersa decemlineata* Say. According to Morris (1938) *Eupelmella vesicularis* Retz. confines itself exclusively to *Microplactron fuscipennis* Zett. as a host and is capable of detecting the presence of its larvæ and pupæ even within the cocoons of the Saw-fly.

The primary relation between the host and the predator is their close proximity. As a rule, both these types flourish in one and the same environment; the surroundings agreeable to one may be presumed suitable to the other, both establishing for themselves an ecological equilibrium. Food being the primary consideration, increase in pest population is normally followed by the corresponding increase in the numbers of its enemies. This statement has a bearing on the laws concerning the interaction of a predator and its prey, *vide* Volterra (1926), since it is concluded that, if the prey is given additional protection the mean values of the populations of both the species, increase. Nevertheless, a keen competition between the two rival factors ensues but usually the activities of the predacious insect predominate and ultimately it becomes a controlling factor, the effect being reproduced automatically. Since a predator multiplies at the expense of the host, the predators will also be affected adversely to some extent.

The greatest achievement, however, is brought about by the fact that predators as a rule, kill far too many individuals than are actually required as food. Thus the performance of a predator differs remarkably from that of a parasite which can kill only one host at a time. Often even this much is far from expectation, since a parasite may deposit more than one egg in one and the same host or if it be a case of superparasitism two or more species of parasites may contribute simultaneously towards the ultimate death of a single host. The capabilities of a predator, on the contrary, are well pronounced and this fact predominates even if a predator is relatively

less prolific or less specific. Clausen (1916) estimated that *Hippodamia convergens* Guer. destroys on an average, 21 aphids a day during its larval stage and the number consumed by the insects of any single species during one life-cycle may go upto 624. Wildermuth (1916) observed that *Chrysopa californica* is capable of destroying 300-400 aphids during its larval life, while according to Simenton (1916) a single larva of *Hyperaspis binotata* Say. may destroy 90 adults and 3,000 coccid larvæ during the entire larval period. Burgess (1911) estimated that on an average, a single larva of *Calosoma sycophanta* L. devours 41 full-grown caterpillars of gipsy moth and the adult may kill 238-272 caterpillars during its life. Certain coccinellids, however, have been observed by various workers to destroy upto 1,000 caterpillars. Morris (1938) states that one larva of *Eupelmella* is capable of eating 20 larvæ and pupæ of *Microplectron* and finally it kills all the remaining living young ones of the host before it pupates. Similar observations support the importance of various species of predators in the control of the pest.

This fact is further strengthened by the observation that in most cases both the adults as well as the larvæ possess predacious habits; their activities, therefore, prove all the more effective in the destruction of pests. This behaviour may even compensate for the slightly lower rate of reproduction although this feature is not of common occurrence. On the contrary, some predators as in Meloidæ are rather prolific and may lay from 2,000–10,000 eggs per female.

Hyper-Predatorism

Some of the useful predators assume the status of injurious insects as a result of which their utility is greatly handicapped since they prey upon other predators. This behaviour is allied to hyper-parasitism and as such works adversely in the control of insect pests. Henson (1937) gives a few instances of this nature and particularly mentions *Thanasimus formicarius*, a predator on bark-beetle. This predator is extremely voracious both in its adult and larval stages but unfortunately it destroys equally readily the larvæ of Rhizophagus and *Euraca* spp., both of which are quite effective predators on the same pest. Their cannibalistic habit may even be extended further when they begin to devour each other in the absence of any food. This undesirable activity interferes materially with the biological control of the pest.

An interesting instance of similar nature to that described above is cited by Morris (1938) where a chalcid *Eupelmella vesicularis* Retz. acts as a predator on another chalcid parasite, *Microplectron fuscipennis* Zett. and on saw-fly, *Diprion sertifer*, in Hungary. It has been observed that once this predator gets established, it definitely brings about an appreciable inhibitory effect upon the efficiency of the primary parasite in the control of the pest.

Such instances of hyper-predatorism or of predators on primary parasites are practically unrecorded in India. However, systematic observations will be needed before we are in a position to confirm its existence in our country.

Application of Predators

Introduction of useful insects has actually yielded results of considerable importance and as in the case of parasites the utility of some of the predators has equally been tried by various investigators in other countries. For instance, *Novius cardinalis* (Imms, 1926) Syn. *Vedalia cardinalis* (Wardle, 1929) proved its efficacy in the control of Fluted scale *Icerya purchasi* of citrus in Hawaii. Similarly *Cyrtorhinus mundulus* (Wardle, *Cytorhinus mundulus*) effected a complete control against *Perkinsiella sacoharicida*, a very serious pest of sugarcane in Hawaii. *Calosoma sycophanta* L. was regarded one of the most important biological factors of control against the gypsy moth in New England. Results of considerable encouragement have also been obtained by the introduction of *Hyperaspis silvestrii* in Hawaii from Mexico, since it completely controlled the Avocordo Mealy-bug, *Pseudococcus nipæ*. Another instance of a perfect control by a predator was through the activity of a coccinellid beetle, *Cœlophora inacqualis* against a black aphid. A similar enterprise of outstanding nature was the control of *Citrophilus* Mealy-bug in California with the help of *Cryptolæmus* lady-bird beetle. In India, similar enterprises have not received much response. Recently, however, Rahman (1940) has contributed a valuable list of the important predators in India and added brief notes on their life-history and seasonal activities.

Husain and Trehan (1933) state that the adults of *B. gossypiperda* (*B. tabacci*), the white-fly of cotton in the Punjab, killed by the larvæ of *Chrysopa* sp. and *Brumus* sp., far exceed that which is actually required for food. Their population in the fields yielded the following results and their application in field cages practically controlled the pest:—

Table I

Date	*Brumus* sp. per 100 plants		*Chrysopa* sp. per 100 plants	
	Adults	Grubs	Adults	Grubs
31- 8-29	52	212	396	1,084
5- 9-29	348	404	321	1,632
24- 9-29	—	—	—	380
3-10-29	128	—	108	240
13-10-29	104	48	60	52
20-10-29	—	95	—	56
1-11-29	—	—	60	—

Rahman (1940) also pointed out that various species of *Aleurodidæ* in the Kulu valley are kept under control through the activities of *Brumus suturalis* and *Scymnus* sp. *Eriosoma lengigerum* (woolly aphis) has quite a number of insect enemies in the Kulu valley. Its relative decrease in numbers during certain parts of the year is generally attributed to the prominence of certain predators, the commonest being *Ballia encharsis*, *Syrphus confrator*, *C. chrysopa* sp., and *Chilomenes bijugus*.

Ayyar (1940) recorded a new species *Scymnus coccivora* which has been regarded as an extremely effective natural control against the *nim* scale, *Pulvinaria maxima*, round about Coimbatore. Kapoor (1939) contributed a short note on the bionomics of *Adonia variegata* Goez., and stated that its larvæ are capable of feeding on 65 aphids during various instars. The adults, on the other hand, may feed on 35-75 aphids per day.

QUALIFICATIONS OF AN EFFECTIVE PREDATOR

Significance of biological control goes with the accurate functioning of the predators utilized for the purpose. A few primary qualifications, therefore, may be considered necessary before a final selection is made.

1. Specificity for a given host is extremely essential since a predator's efficacy depends considerably on this behaviour. A thorough study, therefore, is needed and the range of hosts studied properly. A predator showing the greatest tendency to feed on the pest under consideration should be encouraged.

2. Rate of reproduction and the capacity of preying upon the pest need special attention. A predator which multiplies rapidly and at the same time its individuals are in the habit of destroying too many insects, will prove extremely successful in controlling the pest.

3. Seasonal activity of the predator should coincide with that of the pest. Greater achievements may even be expected if a predator assumes activity slightly earlier than the pest. This will surely facilitate the control because of the superiority of the predators over the pest with respect to their numbers.

4. A predator will achieve maximum efficacy if its multiplication is not checked in any way, by its parasites or predators.

Thanks are due to Dr. Khan A. Rahman, Lyallpur, for valuable suggestions.

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1. Afzal Husain, M., and Trehan, K. N., *Ind. J. Agric. Sci.*, 1933, **3,** 701–53. 2. Burgess, A. F., *Bur. Ent.*, 1911, B. **101,** 1–94 (*vide* Sweetman). 3. Clausen, C. P., *Univ. Calif. Pubs. Ent.*, 1916, **1,** 251–99 (*vide* Sweetman). 4. Elton, C. H., *Animal Ecology and Evolution*, 1930. 5. Henson, H. S., *Bul. Ent. Res.*, 1937, **28** (2). 185–236. 6. Imms, A. D., *Text-Book of Entcmology*, 1934. 7. Iyyar, T. V. R., *Hand-Book of Economic Entomology for South India*, 1940. 8. Kapoor, A. P., *Proc. 26th. Ind. Science Congress, Lahore*, 1939, **3,** *Abstracts*, 146. 9. Morris, K. R. S., *Parasitology*, 1938, **30** (1), 20–32. 10. Rahman, K. A., *Proc. Ind. Acad. Sci.*, 1940, **12,** 67–74. 11. Simenton, F. L., *Jour. Agr. Res.*, 1916, **6,** 197–204 (*vide* Sweetman). 12. Sweetman, H. L., *The Biological Control of Insects, Ithaca, New York*, 1936. 13. Thompson, W. R., *Bul. Ent. Res.*, 1928–29, 19, —; *Parasitology*, 1939, **31** (3), 299–388. 14. Volterra, V., *Mem. Acad. Lincei, Ser.*, 1926, **6, 2,** 37, 31–113 (Reference). 15. Wardle, R. A., *The Problems of Applied Entomology*. McGraw-Hill Book Co., New York, 1929. 16. Wildermuth, *Text-Book of Entomology*, Imms, 1916 (Reference).

SOME ASPECTS OF SHARK LIVER OIL INDUSTRY IN INDIA

BY DR. C. C. JOHN
(Department of Marine Biology and Fisheries, Travancore)

IT is now more than three years since the manufacture of Shark Liver Oil was started on a commercial scale in India and within this short period, it has gained considerable popularity as a substitute for Cod Liver Oil. The industry was first started under the initiative of the Fisheries Departments of Travancore and Madras, but soon other maritime provinces followed the example and in due course, private enterprises also started manufacture. At present, though all these concerns are exploring every possible avenue for increasing production and though the output to-day is much greater than what it was two years ago, it can be safely asserted that, at present, the demand is much in excess of available supplies.

It is a generally accepted fact that dislocation of International trade due to conditions of war, provides opportunities for developing indigenous industries. This is well exemplified by the growth of Shark Liver Oil industry in India. Though Shark Liver Oil was known to possess high vitamin potency it was never able to find a market in competition with Norwegian Cod Liver Oil during pre-war days. But, when the supply of Cod Liver Oil was completely cut off and when the medical profession began searching for a suitable substitute, the valuable researches and propaganda conducted by the Nutrition Research Laboratory at Coonoor, assured confidence regarding the suitability of Shark Liver Oil and very soon this new product found a place on every chemist's counter in many parts of India. But this meteoric development had its disadvantages. In the midst of heavy rush of orders and efforts to increase production there was hardly any breathing space to realise the necessity for improving methods of manufacture, based on correct principles of fish oil technology. If, however, this tendency to ignore the necessity of improving quality is allowed to prevail unchecked, it may ultimately prove disastrous to the future of the industry and once more yield to the influx of foreign products when conditions return to normal. Stabilisation of the industry will be possible only if side by side with every effort to increase production, equal, if not greater, attention is concentrated on improving and standardising quality through scientific investigations.

Researches on fish oils so far undertaken in India relate to the determination of vitamin A potency and the specific chemical properties of the oils of some of the common varieties of sharks found in Indian seas. On the manufacturing side, however, no work of any importance seems to have been carried out nor any endeavour made to adopt the technical principles followed elsewhere. The disadvantages resulting from the neglect of this aspect may be summarised as follows:—

Fish oils tend to become rancid when stored for more than a limited period of time. Peroxides formed during the process, cause rapid destruction of vitamin A. If, therefore, the vitamin is to be preserved, oxidative rancidity should be prevented. The method of extraction, storage, influence of light and the degree of unsaturation, are all important factors which control the development of peroxides. In foreign countries antioxidants derived from certain seeds are used for the stabilization of fish oils but this is mostly kept as a closely guarded trade secret. It is necessary to prepare extracts of the indigenous seeds and test them so as to discover a suitable antioxidant.

The removal of sterine from Shark Liver Oil is an important process which determines the quality of oil for human consumption. At present raw oil is cooled at random. But

since a suitable method has not been developed the precipitated sterine is not always in a form in which it can be easily filtered. It has been found that the crystallisation of sterine is very sensitive to changes in the rate of cooling and so the most economical and efficient method of sterine separation will depend on the determination of the rate of cooling for oils extracted from the livers of various types of sharks. The prevention of sterine formation in cleared oils by means of protective colloids is also an important problem.

Vitamin A potency of Shark Liver Oil is the chief factor which determines the value of the oil. It is, therefore, worthwhile to enquire how far this property is safeguarded under the prevailing systems of uncontrolled and emperical methods of manufacture. There are a number of brands of Shark Liver Oil now in the market and in the majority of cases the vitamin values are not specified. Almost all of them maintain that their vitamin potency is more than double that of ordinary Norwegian Cod Liver Oil. However, it may be pointed out that the latter is not known to contain more than 500 International Units of vitamin A per gramme whereas the average vitamin content of Shark Liver Oil is 10,000-12,000 International Units per gramme. Therefore, the statement that Shark Liver Oil contains double the vitamin content of ordinary Cod Liver Oil would imply that four or five volumes of some vegetable oil has been mixed with each volume of pure Shark Liver Oil. This process is called blending and though the ostensible aim is to standardise the finished product, the method followed is not quite satisfactory. If blending is designed to bring the vitamin content to a constant proportion, the vitamin value of each sample of Shark Liver Oil should be determined and on that basis the quanity of groundnut oil to be added must be calculated. In other words, specific and seasonal variations in the vitamin content of Shark Liver Oil should form the basis for calculating the proportion of blending. But is blending after all, indispensable? The vitamin content of halibut liver oil, for example, is many times higher than that of Shark Liver Oil and, if the principle of blending is accepted as a general rule, it would imply that halibut liver oil should also be blended in a similar manner. In actual practice, however, this is not done. The properties of the oil are conserved in tact, while the dosage is reduced in an inverse ratio, so that in cases where a few ounces of ordinary Cod Liver Oil is necessary, a few drops of halibut liver oil will suffice. If, therefore, it is feared that the vitamin concentration of Shark Liver Oil is high, all that is necessary is to specify the actual values so that physicians may regulate dosage according to requirements of individual patients. This will eliminate the necessity of blending and conserve the original properties of the oil unaltered.

In the methods of manufacture also there are certain inherent handicaps which contrast Indian conditions with those of other countries. For example, in America, during the halibut fishing seasons, fleets of fishing vessels go out into the Atlantic and the livers collected are at first frozen or steamed before being shipped to the coast, where entire lots are sold to one or other of the big manufacturing companies such as Parke Davis & Co., Abbot Laboratories, Mead Johnson & Co., or E. R. Squible & Sons, at competitive rates. This system not only ensures large supplies but also facilitates the development of self-contained factories. In India on the other hand, there are no specified shark fishing seasons and there are no boats specially equipped for the purpose. The uncertainty and scattered nature of the catches do not favour the development of centralised factories for the extraction of oil but compel the necessity of encouraging production on a cottage industry basis. This system would have been satisfactory if the fishermen readily adopted improved methods of extraction advocated by the Fisheries Departments. But they still persist in following crude indigenous methods which, they believe, ensures higher yields of oil; the product is often adulterated with other oils such as turtle oil and oil of leather jackets.

Shark Liver Oil having now been generally accepted as an efficient substitute for Cod Liver Oil, the responsibility of manufacturers to maintain a high quality is indeed very great but in many cases, they seem to ignore this necessity. In Western countries, where fish oils are manufactured on a large scale, an analytical section forms an essential component of the organisation and every sample of oil, as soon as it is prepared, is tested and certified before it is placed on the market but in India though analysis has been voluntarily taken up by a few important scientific laboratories,—to whose labours much of the popularity of the oil is due—since there is no co-ordination between these laboratories and manufacturing concerns, reports of analysis have no bearing on the quality of the product offered in the market. Samples analysed are those specially prepared in the laboratories, whereas the commodity sold in the market is largely what is purchased from fishermen. The two have no comparison and in most cases, are widely different. If, therefore, the Shark Liver Oil industry in India is to be stabilised on a pharmaceutical basis, it is very essential to control production and to exercise a more vigilant supervision of the methods of manufacture.

Owing to the uncertainty of catches, the production of oil on a cottage industry basis has been regarded as the surest and the only practicable scheme, but the unreliability of the methods of extraction, complete disregard of the principles of cleanliness and the susceptibility to adulteration, are factors which argue very strongly against the continuance of this practice. If the quality and purity of the oil are to be ensured, extraction must be carried out under expert supervision during every stage in the process of manufacture and there must be an intimate co-ordination between scientific and manufacturing sections. But so long as collection and manufacture are thrown open to the public such a supervision and co-ordination will be ineffective. The only alternative, therefore, is to centralize manufacture under the supervision of Government Departments and completely exclude private agencies from direct dealings with fishermen. Such a step will ensure maximum utilization of the raw product to the best advantage without being wasted or rendered valueless by irresponsible handling or indifferent methods of extraction, and also promote the development of centralised factories.

LETTERS TO THE EDITOR

A SELF-STABILISED HIGH VOLTAGE SOURCE FOR GEIGER COUNTERS

Several methods* of obtaining stabilised high voltages have been described. In all of them, a separate rectifier and a separate stabiliser, bias batteries, etc., have been used. A self-stabilised high voltage source is being developed and its circuit is shown in Fig. 1.

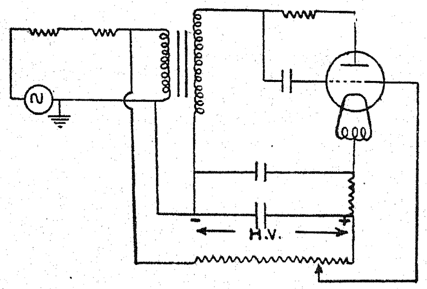


Fig. 1

The circuit is self-explanatory. By introducing an air gap in the central leg of the high voltage transformer, some degree of stability is obtained. By adjusting the bias to the grid of the rectifier, the stability is increased. Feeding back the D.C. output current to the primary further improves the stability of the output voltage. The coupling between the plate and grid by a condenser reduces the ripple to an unnoticeable extent and also improves the stability. The primary circuit contains lamp resistances which reduce surges and regulate the output voltage.

In such a circuit, it is found that a mains voltage variation of 60 volts in a 230 volt supply produces a variation in the output voltage of less than 10 volts. An output current change of ten micro-amperes produces no perceptible change in the output voltage. In this circuit, a power tube of the receiving type is used and as such cannot be operated with a high current drain at voltages above 1,000 volts. Consequently the polarisation of the core by D.C. flow has to be reduced considerably at such voltages. Even if this is done, the worst instability obtained corresponds to one volt in the output per one volt change of the mains voltage. A complete description of its operation will be published in due course.

Cosmic Ray Research Unit,
Indian Institute of Science,
Bangalore,
August 16, 1943.
S. V. Chandrashekhar Aiya.

* Webster, *Proc. Camb. Phil. Soc.*, 1931, **28**, 121. Street and Johnson, *J. Frankl. Inst.*, 1932, **214**, 155. Richards, *Rev. Sc. Inst.*, 1933, **4**, 479. Evans, *Ibid.*, 1934, **5**, 371. Ginrich, *Ibid.*, 1936, **7**, 207. Ashworth and Muzon, *Ibid.*, 1937, **8**, 127. Neher and Pickering, *Ibid.*, 1939, **10**, 53. Hartman, *Electronics*, 1932, **6**, 43.

THE TEA POLYPHENOL OXIDASE—ITS MATERIAL NATURE

In previous studies[1] the tea oxidising enzyme was characterised as a polyphenol oxidase, mainly by reason of its substrate specificity. The question then arose whether tea oxidase was also analogous in its material and chemical nature to such other polyphenol oxidases[2,3] which are known to be copper-protein compounds.

Copper has been detected in all preparations of tea enzyme. But the crude preparations were found also to contain manganese and iron, both associated with other types of oxidising enzymes.[4,5] On purification, however, iron and manganese were completely eliminated from the enzyme while the preparations got enriched in their copper content.

The purification of enzyme was effected as follows:—The acetone preparation of the enzyme was extracted with Sörenson's glycine buffer at pH 10·1, and after adjusting the pH of extract to 6·0 the enzyme was precipitated by a fractional saturation with Am_2SO_4. The precipitate obtained between half and full saturation was collected, dispersed in water and dialysed. Further purification consisted in an adsorption on freshly prepared calcium orthophosphate gel and subsequent elution. By this method tea oxidase has been purified to a concentration of at least 800 times that present in fresh leaf.

Some typical results for the activities and the copper contents of the preparations during the different stages of purification are given

below. Activities represent mg. ascorbic acid oxidised in a catechol-ascorbic acid substrate in 1 hour at room temperature.

Stage of Purification	Activity per g. dry enzyme	Cu content μg. per g	Cu per unit activity
1. Acetone prepared enzyme	151	32	0·21
2. Crude extract	330	60	0·18
3. Am_2SO_4 full saturation precipitate	3546	335	0·09
4. After one adsorption on Ca_3PO_4 gel and elution	5000	357	0·07
5. After a second adsorption and elution	10100	800	0·08

Thus in the more active preparations there exists a fair proportionality between activity and copper content, showing thereby that Cu forms the active group of the enzyme.

Further proof of this is furnished by the fact that on dialysis against KCN solution tea oxidase becomes completely inactivated due to removal of the bound Cu.

It is, therefore, concluded that tea oxidase is a metallo-protein with Cu as its prosthetic group. As such it takes its place along with the other polyphenol oxidases whose constitution and mechanism have been fully worked out.

Tea Research Institute of Ceylon,
Talawakelle,
Ceylon,
H. B. SREERANGACHAR.
June 10, 1943.

1. Lamb and Sreerangachar, *Biochem. J.*, 1940, **34**, 1472, 2. Kubowitz, *Biochem. Z.*, 1938, **299**, 32. 3. Keilin and Mann, *Proc. Roy. Soc.*, 1938, **B125**, 187. 4. Bertrand, *Compt. Rend.*, 1895, **121**, 726. 5. Green, *Mechanism of Biological Oxidations*, 1940, p. 11, Cambridge.

PREPARATION OF DIAZOMETHANE

A FAIRLY quick and economical method of preparing diazomethane from acetamide is described.

The preparation of diazomethane by Arndt's method[1] is expensive and the starting substance, methyl urea, is not readily obtainable. An alternative method has been suggested by Adamson and Kenner[2] which is economical but which involves long and troublesome preparative work.

During work on the synthesis of the ketonic terpene, umbellulone from isovalerianic acid, and of caryophyllanic acid, supplies of diazomethane in quantity were required and a method of preparation from acetamide, based on the work of Brüning[3] was found economical and quick.

EXPERIMENTAL

Aqueous sodium hydroxide (10 per cent.) was added slowly to acetamide (100 gms.) and bromine (45 c.c.) with shaking until the solution was permanently pale yellow, first with ice-cooling and then after heating on the water-bath. On cooling, the acetyl methyl urea (m.p. 179-180° C.) was collected, a further quantity being obtained by concentration of the filtrate (total yield 75 gms.). The acetate was hydrolysed by heating for 3 hours with 8 per cent. hydrochloric acid (200 c.c.), the solution cooled in ice and a saturated solution of sodium nitrite (37 gms.) added with the stem of the tap funnel below the level of the liquid. The nitrosomethylurea (52 gms.) was collected, washed with a small quantity of cold water, and dried in a vacuum. The nitrosomethylurea may be stored in quantity provided it is kept at 0° C., as at ordinary temperature it decomposes slowly.

Diazomethane was then prepared in ether solution by adding aqueous potash and ether to the nitrosomethylurea and distilling from a water-bath at about 60° C.

This work was carried out in the University College of North Wales, Bongor, under the direction of Dr. G. R. Ramage and Prof. J. L. Simonsen.

Inspectorate of Military Explosives,
Kirkee,
M. D. OWEN.
August 14, 1943.

1. *Organic Syntheses*, **15**, p. 48. 2. *J.C.S.*, 1937, p. 1551. 3. *Ber.*, 1888, **21**, 1809; and *Annalen*, 1889, **253**, 6.

A NOTE ON THE ALKALOIDS OF *COSCINIUM FENESTRATUM* (COLEBR.)

THOUGH previous workers[1,2] had suggested the presence of the alkaloid berberine in the stems, Katti and Shintre,[3] in the course of a complete investigation of the stems, noted the probable presence of two alkaloids. They reported that the alcoholic extract of the plant stems contained ceryl alcohol, hentriacontane, sitosterol, palmitic and oleic acids, sitosterol glucoside, saponins, glucose and a large amount of a mixture of alkaloids, together with some resinous material. The melting points of the two alkaloids obtained by them in a pure condition did not correspond with that of berberine recorded in the literature (145° C.).

The present work was undertaken to verify the presence or absence of berberine and of any other alkaloid.

An alcoholic extract of the roots was thoroughly extracted, first with water and then with dilute acetic acid. The insoluble residue did not give any test with alkaloidal reagents. From the aqueous and acetic acid extracts the alkaloids were completely precipitated as nitrate (1·6 per cent.) by adding a solution of potassium nitrate. The filtrates did not show the presence of any other alkaloid in solution. The yellow alkaloidal nitrate was found to contain only berberine from a study of the nitrate, the hydrochloride, the platinichloride and the acetone compound as well as the free base regenerated from the acetone compound. These compounds were compared with the corresponding compounds prepared from pure berberine and found to be identical. The free base also gave the usual colour reactions for berberine.

As a result of the investigation it was proved beyond any doubt that the alkaloidal content of *Coscinium fenestratum* consists of berberine

only. The alkaloidal crystals obtained by Katti and Shintre, and also obtained by us by following their method, were not free berberine but salts of berberine and, therefore, naturally did not give the melting point of pure berberine. Presumably they were salts of two different acids, as they obtained crystals with two different melting points. It was not thought to be of sufficient importance to isolate and identify these acids.

EXPERIMENTAL

The drug was purchased from a local dealer and identified in the botanical department of the University College.

The powdered air-dried stem (180 gms.) was defatted with petrol and soxhleted with alcohol. From the alcoholic extract (9·2 gms.) warm water dissolved 6·2 gms. From the insoluble residue, the remaining alkaloids were dissolved out with warm 4 per cent. acetic acid and precipitated as nitrate with strong potassium nitrate solution (A).

The aqueous extract, on concentration and cooling, gave a crystalline alkaloidal material (·8 gm.; B), which was also converted to the nitrate. The aqueous filtrate, also gave a nitrate, (2·6 gms.; C).

BERBERINE-ACETONE COMPOUND

0·1 gm. of the nitrate was dissolved in water (10 c.c.) and mixed with 2 c.c. of 10 per cent. aqueous sodium hydroxide, heated to 50° C. mixed with 5 c.c. of acetone and set aside. A lemon yellow powder separated. Melting point 167-169° C. (decomp.).

BERBERINE REGENERATED FROM ACETONE COMPOUND

The free base was liberated from the acetone compound by boiling 0·2 gm. of it with alcohol on a water-bath. The alcohol was driven off and the residue recrystallised from water. It melted at 145° C. both alone and after admixture with a sample of pure berberine.

The authors thank Dr. K. L. Moudgill, Director of Research, for his interest in this work.

Central Research Institute, Trivandrum,
June 11, 1943.
N. S. VARIER.
P. P. PILLAI.

1. Perrins, *Ann.*, **83**, 276 2. Chopra, *Indian Medicinal Plants*, p. 295. 3. Katti and Shintre, *Arch. Pharm.*, 1930, **268**, 314–21.

CATALYSIS OF VANADATE-HYDRIODIC ACID REACTION BY THE OXALATE ION

IN a previous publication[1] we reported the catalysis of the reaction between dichromate and hydriodic acid by the oxalate ion. We have carried out a survey of numerous reactions involving the oxidation of hydriodic acid by such substances as hydrogen peroxide, potassium persulphate, sodium arsenate, potassium chlorate, potassium bromate, and potassium iodate to ascertain the possible catalytic effect of oxalate ion. No catalytic effect was observed in these cases. It was, however, found that the oxalate ion has a profound accelerating action on the reaction between vanadic acid and hydriodic acid.

The reaction was followed by titration of the iodine liberated with sodium thiosulphate. The concentration of sodium vanadate was varied from 0·025 N to 0·00025 N and that of sodium oxalate from 0·225 N to 0·0005 N. The reaction was studied in the presence of air, in vacuum, and in an atmosphere of carbon dioxide.

In seeking an explanation for the mechanism of the catalytic action of oxalate ion on these reactions, we have to take into account the numerous resemblances between chromates and vanadates. Both chromic acid and vanadic acid form poly-acids, and, possibly, complexes with oxalic acid. It seems, therefore, that in the reaction between chromate and hydroidic acid, the oxalate catalysis is more concerned with the chromate than with the hydriodic acid. This idea received further support from our recent observation[2] that the reaction between dichromate and hydrobromic acid is also catalysed by oxalate.

Full details will be published elsewhere.

Andhra University,
July 6, 1943.
C. R. VISWANADHAM.
G. GOPALA RAO.

1. Viswanadham, C. R., and Gopala Rao, G., *Curr. Sci.*, March 1942, **11**, No. 3, pp. 102–103. 2. *Ibid.*, June 1943, **12**, No. 6.

A NEW STEM-BASE DISEASE OF *ALTISSIMA* CAUSED BY A SPECIES OF *PHYTOPHTHORA*

FOR the first time during the year 1930 *Phytophthora* was reported[1] by this section to cause diseased lesions on the stem of altissima (*Hibiscus sabdariffa* Lin. var. *altissima*). *Altissima* supplies the Roselle Hemp of Commerce, and is noted for its good silky fibres, much stronger than jute and can be used in some proportion in the manufacture of ropes, cordage, etc.

The disease as observed since 1930 is characterised by the production of discoloured patches on the stem. If the stem is still green, the patch appears at first as a water-soaked, slightly yellow patch at the base of the stem; with time the lesion enlarges, darkens and becomes brown in colour and the infected tissues (the excambial layers) dry up resulting in shreds and cracks and thereby exposing the pith inside. Ultimately the leaves begin to wilt and the plants gradually dry up and die prematurely. In case they do not completely succumb, the fibres at the infected regions are damaged thereby depreciating greatly the quality of the yield.

The first infection usually takes place on the lower portion of the stem and more often near about the collar region; but the production of these lesions are confined within 2 to 3 feet from the ground level. The number of lesions in any single plant varies from a few to half a dozen and the size of the individual lesions from half an inch to many inches in length and may partially or completely girdle the stem. One or more lesions may coalesce together to form diseased surface of considerable length. If rain or very humid conditions prevail for a number of days gums are sometimes seen exuding from old and large lesions; such conditions also favour the growth of fungus mycelium from the margins of these spots.

The plant may be attacked at any stage of

its growth—from seedling till when almost full grown. But the attack and the spread of the disease is much favoured by the continued presence of damp, cloudy days or rains. Once started the lesions grow on and are not much hampered in their progress despite changes in weather conditions. But it must be stated that few new infections take place under dry conditions.

Cultures of diseased tissues as well as inoculation experiments have demonstrated that the pathogen responsible for this malady is a species of *Phytophthora*. This species of *Phytophthora* produced good growth of mycelium as well as sporangia in potato-dextrose-agar medium. The sporangia are ovoid in shape, measuring from $19 \cdot 2$-$48\,\mu \times 18 \cdot 0$-$33 \cdot 6\,\mu$ with papilla $4 \cdot 8$-$7 \cdot 2\,\mu$; vegetative hyphæ varying from $4 \cdot 8$-$9 \cdot 6\,\mu$ in width.

Detail work regarding the specific identification of the fungus, its physiological behaviours together with control measures are in progress.

Our thanks are due to Dr. S. Hedayetullah, for his kind interest.

Section of the Economic Botanist,
Agricultural Research Station, P. C. Kar.
Dacca (Bengal), J. C. Saha.
June 11, 1943.

1. *Ann. Rept. of the 1st Economic Botanist to Govt. Bengal, for the year 1930-31* (*Abs. Rev. Appl. Myco.*, 1931, **11**, 157-58).

KARNAL BUNT, AN AIR-BORNE DISEASE

In a recent paper[1] I have shown that the bunt of wheat caused by *Neovossia indica* (Mitra) Mundkur is not a seed or soil-borne disease, experiments conducted during four years having given consistently negative results. These experiments have been repeated in 1942-43, not only at New Delhi but at Simla and at the Tarnab Farm, Peshawar, but with uniformly negative results. In the crop year 1941-42, bunt appeared in an epidemic form and at Karnal, up to 35 per cent. of the ears were infected. Seed from that crop was sown in the same fields in 1942-43 and the crop carefully examined. There was little or no bunt and only nine infected ears were found after careful search. These additional data further confirmed the belief that Karnal bunt is not seed or soil-borne. It will be noted that the experiments were designed with the idea that this bunt like a majority of bunt and smut diseases is a systemic disease, infection taking place in the seedling stage. Examination of a large number of ears attacked by *Neovossia indica* and of some attacked by *Tilletia caries* (DC.) Tul. or *Tilletia fœtida* (Wallr.) Liro, has shown that such is not the case.

Plants infected by *Tilletia caries* or *Tilletia fœtida* are sometimes dwarfed and bluish green to greyish green. The bunted ears are darker green and remain so longer than the normal heads. Attacked plants may be wholly or partially bunted. Even though a majority of the heads are completely attacked, partially attacked heads are known, half the ear or one side or one edge alone being infected. In a partially bunted head the bunt balls and the kernels are not distributed irregularly; in fact, the former stand by themselves one above the other in a regular manner. McAlpine,[2] while granting that partially bunted kernels are exceedingly rare, has on some occasions found them. Recently Gassner[3] found that in Turkey wheat kernels partially infected by *Tilletia fœtida*, are more common but their mode of occurrence makes it clear that initial infection must be from an internal systemic mycelium.

As a rule the fungus attacks each growing-point of the stool at an early stage but some tillers may escape infection, the later ones not succeeding in escaping, so that partially bunted plants result. Sometimes the fungus may be confined to a part of the meristem, resulting in a strand of infected tissue below the growing point and a bunted strip along one side of the head alone. These are, however, extremely rare cases.

As against these symptoms, the plants infected by *Neovossia indica* are never dwarfed nor is their colour changed. An ear in which all

Fig. 1

Tilletia caries on right. *Neovossia indica* in centre and *Tilletia fœtida* on left.

the grains are infected has not yet been seen. Not more than five or six kernels in a head are attacked, of which one or two are turned into complete smut balls, the rest of the attacked kernels being partially attacked. The remaining kernels in the head are unaffected. The attacked kernels occur very irregularly and do not conform to any ordered arrangement; in fact the kernels at the base may be perfectly healthy but two or three at the centre and a few at the apex may be affected. The mode of attack of the kernels makes it manifest that initial infection must have been external. Such a condition is the rule rather than an exception in this bunt. Examination of bunted ears indicates that *Tilletia caries* and *Tilletia fœtida* are ovaricolous and *Neovossia indica* is fructicolous. Furthermore, the irregular manner of occurrence of infected kernels in the latter indicates that only those grains are infected where the spores brought

by an external agency have settled down, each bunted grain representing a single, strictly local infection.

Apparently the spores or the sporidia wafted by wind settle down on the ears in the "anthesis" or the "dough" stage and the kernels ultimately get attacked. At that time the spores are not formed in the heads but those of the previous season lying about in the fields on stubble or other wheat refuse, evidently germinate in January or February when there is enough moisture and sufficiently low temperature, forming promycelial tubes, at the apex of which a whorl of sporidia, up to 150 or even more, is formed. The large number of sporidia ensures that some of them at least will find the congenial host. In the other two bunts the number of sporidia is eighteen to twenty, but they being seed-borne, the spores lie in close proximity of the host and it is not necessary to produce a larger number. The Promycelial tubes of *Neovossia indica* are rather long, which ensures that the sporidia if buried, reach the surface with every chance for being carried by wind. The spores themselves are rather large; but the sickle-shaped sporidia are light and can be easily carried by wind. The spores evidently play a passive part, the aggressive parasitic role being assumed by the sporidia.

To prove the above assumptions experiments were carried out at Delhi and at Simla during the past season with successful results. Moore's[4] vacuum method of infecting the ears was used. Prior to infection the spores were in some cases soaked for four days and after infection the heads were labelled and covered with paper bags. Infections were made in February and March at Delhi and in April at Simla.

At Delhi, five out of five infected ears of IP 114 and two out of six ears of IP 165 showed attack and in the infections carried out at Simla, six out of sixty-four of IP 165, twelve out of fifty-four of C 591, and twenty out of 303 of IP 125 were bunted. This is the first occasion when such a large number of artificially bunt-infected ears has been obtained. Instead of using the spores had I used sporidia, the percentage of infection would have been greater. Unfortunately the germination of the spores is very capricious and the exact conditions for obtaining uniform germination are unknown. Effort will hereafter be directed towards finding those conditions. Very low temperature and sufficient quantity of moisture appear, however, to be necessary. In 1942 there were 2·54 inches of rain in the second half of January and 4·51 inches in February, as against traces and 0·15 inches, during corresponding periods in 1943, at Karnal. There was not much difference, however, in the temperatures. Bunt appeared in an epidemic form in 1942 while it was scarce in 1943, apparently due to the above cause.

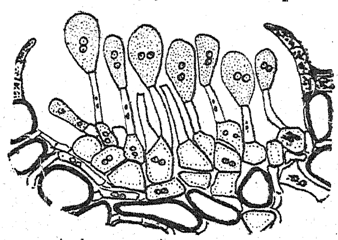
Imperial Agricultural Research
Institute, New Delhi,
July 5, 1943. B. B. MUNDKUR.

1. Mundkur, B. B., *Indian J. Agric. Sci.*, 1943, **13**, 54-58. 2. McAlpine, D., *The Smuts of Australia*, *Melbourne*, **1910**. 3. Gassner, G., *Phytopath. Z.*, 1938, **11**, 451-68. 4. Moore, M., *Phytopathology*, 1936, **26**, 397–400.

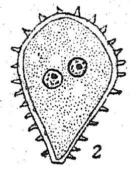
A NEW RUST DISEASE OF CARDAMOMS

A LEAF-RUST on *Elettaria cardamomum* Maton was collected by the writer in the plantations round about Balehonnur which, on examination, appeared to be a species new to science. No rust-disease of the cultivated cardamoms are known to occur in India or any other country, and Mayne[2] makes no mention of any cardamom rust in his recent report on the cardamom cultivation in India. The infection first appearing as a tiny yellow spot gradually spreads into a patch. The sori that are formed throw up masses of powdery white spores. After the dispersal of the spores the infection patches dry up appearing as blotches formed by sun scorch. The mycelium continues to perennate along the margin of the dried patch, and when conditions are favourable they develop fresh sori. The rust is widely distributed in South India, rusted specimens having been collected by the writer in the various estates of Kodaikanal Hills and plantations in the Mysore State.

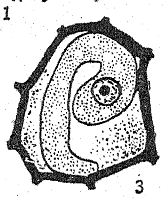
Only uredia have been observed for the rust. They are subepidermal, erumpent and pulverulent, white and aparaphysate (Fig. 1). The urediospores arise singly on short pedicels, and



1



2



3

FIG. 1. Uredium × 560.
FIG. 2. Urediospore × 1,800.
FIG. 3. Haustorium within the host cell × 1,260.

distinctly show a binucleate condition. Mature spores are ovate-elliptic (Fig. 2), white, echinulate, with an indistinct germ pore and measuring 26-32·5 × 19-17·4 μ. The urediospores reinfect the same host and cause secondary infection.

The only other rust recorded on the genus *Elettaria* is *Schrœteriaster Elettariæ* recorded by Raciborski[3] from Java on *Elettaria speciosa*. The urediospores of this rust are stated to be ovate-elliptic, orange-yellow, and measuring 24-30 × 15-20 μ and telia in subepidermal lenticular crusts with hyaline teliospores in short chains. Mains[1] who critically examined the type species of *Schrœteriaster* noticed that in addition to the characters ascribed for the genus, persistent hyaline basal cells were also present, a character which clearly distinguished the genus from *Phakopsora* and *Bubakia*. In one instance what appeared to be an immature telium, composed of binucleate superposed

cells was observed by the writer. In the absence of any mature telium it would be best to retain the rust under *Uredo*. The urediospores of *Schrœteriaster Elettariæ* are orange-yellow, measuring 20-34 × 15-20 μ as against the hyaline spores of the rust under study which measure 26-32·5 × 19-27·4 μ. The rust can be accommodated only as a new species and the name *Uredo Elettariæ* Thirumalachar is proposed.

Uredo Elettariæ THIRUMALACHAR SP. NOV.

Uredia amphigena, subepidermalia, erumpentia, albida et aparaphysta; urediosporæ ovatæ-ellipsoidæ, echinulatæ, poris germ. indistinctis, magnitudinis 26-32·5 × 19-27·4 μ. Hab. on vivis foliis *Elettaria cardamomum* Maton, leg. M. J. Thirumalachar, 14-4-1940, Balehonnur, Mysore State, type deposited in the Herb. Crypt. Ind. Orient, New Delhi.

Department of Botany,
Central College,
Bangalore,
July 6, 1943.
M. J. THIRUMALACHAR.

1. Mains, E. B., "The status of the genus *Schrœteriaster*, *Ann. Mycol. Berl.*, 1934, **32**, 256–59. 2. Mayne Wilson, W., Report on Cardamom cultivation in South India, *Misc. Bull.* No. 50. *Imp. Counc. Agri. Res.*, India, 1942, pp. 1–67. 3. Raciborski, M., *Parasitische Algen und Pilzen Javas*, 1900, **2**, 28–29.

PYRETHRIN CONTENT OF INDIAN PYRETHRUM

DURING the past few years much interest has been taken in the cultivation of pyrethrum (*Chrysanthemum cinerariæfolium* Boic.) in India and with the help of the Imperial Council of Agricultural Research experimental cultivations have been started at a number of stations. As reported by Burns,[1] pyrethrum has failed to establish itself at Dharwar, Poona, Saharanpur, Dehra Dun, Chaubattia (Ranikhet U.P.), Sakrand (Sind), and Ranchi, but the attempts have succeeded at Murree, Kulu, Palampur, Kashmir and since the time of the above report, also at Shillong, Mayurbhanj, Kodaikanal, Coonoor and Mysore.

It is well known that success in the cultivation of pyrethrum depends upon the type of soil, altitude of the locality, climate, distribution of rainfall, cultural and manurial treatment, conditions of flowers at harvesting, etc. Full data are not yet available for all the stations where pyrethrum has been a success and in their absence it is not possible to discuss the reasons why the pyrethrum grown at Kodaikanal is superior to that grown in Murree but it may be stated that the Indian experiments appear to prove what has been established elsewhere, namely, that pyrethrum grows best in localities with 40-80 inches of rainfall, well distributed throughout the year. Pyrethrum failed to flourish in Dehra Dun because of nearly 60 inches of rainfall during the three rainy months, which damped off the plants.

In the following table the pyrethrin content of pyrethrum flowers (open), obtained from different localities, is recorded and for comparison the figures for Kenya, Japanese and Dalmatian flowers are also given. All the figures given in the table are comparable, as they have been obtained by the same method

Locality	Altitude	Annual rainfall	Normal rainfall in July, August and September	Pyrethrin I	Pyrethrin II	Total Pyrethrins
	ft.	in.	in.	%	%	%
Kashmir						
Tangmarg	7,200	15 + winter snow	11	0·35	0·57	0·92
Baramulla	5,200	38	6	0·32	0·62	0·94
Punjab						
Palampur	4,500	101	72	0·22	0·68	0·90
Murree	7,113	57	31	0·37	0·66	1·03
Kulu	4,500	39	15	0·35	0·40	0·75
N.W.F. Province						
Tarnab	2,000	17	6	0·31	0·59	0·90
United Provinces						
Dehra Dun	2,239	87	59	0·63	0·15	0·78
Garhwal						
(Pandar range)	4,000	70	44	0·29	0·28	0·57
Madras						
Kodaikanal	7,688	62	19	0·76	0·62	1·38
Coonoor	5,730	64	10	0·44	0·45	0·89
Assam						
Shillong[4]	4,921	84	40	—	—	1·41
Orissa						
Mayurbhanj[6]	1,600	60	32	—	—	1·15
Mysore						
Bangalore[5]	3,021	35	16	—	—	0·8[illegible]
Kenya	7–9,500	40–65	—	0·77	0·56	1·33
Japan	—	40–80	—	0·38	0·63	1·01
Dalmatia	—	40	—	0·35	0·63	0·98

of assay, namely, a combination of Seil[2] and Pantsios.[3]

Forest Research Institute,
Dehra Dun, S. V. PUNTAMBEKAR.
June 6, 1943.

1. Burns, *Indian Farming*, 1941, **2**, 58. 2. Seil, *Chem. Trade J.*, 1934, **85**, 168. 3. Pantsios, *Ind. and Eng. Chem.*, Anal. Ed., 1935, **10**, 386. 4. Chakrabarti, *Indian Farming*, 1942, **3**, 12, 652. 5. Anon, *Ibid.*, 1942, **3**, 8, 441. 6. Lahiri, Ghose and Chopra, *J. Amer. Pharm. Assoc.*, 1941, **30**, 72.

THE *KURRAM SANTONICA*

THE *Kurram santonica* has been commercially exploited for manufacturing santonin since 1927. On account of its great economic value its cultivation has been considerably extended in the valley resulting in a remarkable increase in the annual yield. Repeated attempts were made in the past to introduce the Kurrum santonin into the adjoining territories of the Khyber, Waziristan, Malakand agency, Chitral and Kaghan, but so far these have not been successful. The failure is chiefly due to defective methods of cultivation.

Krishna and Varma[1] attempted to grow artemisia at Dehra Dun, and they reported that the plant raised from seeds obtained from the santonin containing Kurram *Artemisia* "produces flower-heads twice a year and consequently has two periods of maximum santonin content, namely, June and December".

It may be pointed out that the climatic conditions during the months of June and December are entirely different. The appearance of two regular crops of flower-heads and leaves on the same branches of the same plants during two extremely different climatic conditions is most extraordinary. With regard to *Artemisia* growing under natural or proper cultural conditions such a phenomenon is least expected. There is no evidence available from any other quarter in support of it. Two periods of maximum santonin content at two different flowering periods during one year is not only out of harmony with their previous finding but is also not a natural phenomenon as far as *Artemisia* is concerned.

In the case of the *Kurram santonica*[3] there are two maxima from the point of view of santonin content. One when the new leaves are fully developed in late spring and the second when the immature unopened flower-heads are well developed.

Artemisia has been under cultivation in the botanic garden of the Islamia College for the last ten years. The plants were raised from seeds brought from the Kurram valley and the Khyber. Transplants were also brought. All the plants are doing very well. I have been carefully watching the appearance of flower-heads of the santonin-containing as well as the santonin-free forms of *Artemisia*. I have been several times to the Kurram valley, Khyber, Waziristan, Kaghan valley, Baluchistan and some parts of Afghanistan, where *Artemisia* grows wild in great abundance. I[2] have "in no case observed the normal appearance of two (regular) crops of flower-heads in a year" on the same plants. It has, however, been observed in the case of santonin-free and some hybrid forms, that the flowering is late as compared with the genuine santonin-containing form and the flowering period is very much prolonged with the result that in some cases the plants bear fresh flower-heads side by side with old withered flower-heads. In the case of the genuine santonin-containing form the flowering period is earlier and comparatively much shorter."

Moreover, in the case of some cultivated plants it was observed last year that if the vegetative shoots are cut off just before the appearance of the flower-heads, the flowering period is much delayed. Further work in this connection is in progress.

Islamia College,
Peshawar, M. A. QAZILBASH.
June 14, 1943.

1. Krishna and Varma, *Quart. J. Pharm. Pharmacol.*, 1933, **6**, 23. 2. Qazilbash, *Ibid.*, 1942, **15**, 323. 3. Coutts, *Ibid.*, 1934, **7**, 404.

THE cultivation of *Artemisia* in Dehra Dun was attempted on the strength that the plant being Zerophytic would perhaps flourish even in a wet locality. Our experiments have shown that given proper care, *Artemisia* can be grown but that Dehra Dun is not a fit place at all. Therefore these experiments have long been dropped and the observations made earlier have never had the opportunity of being checked.

The plants that showed two flowering periods were remnants that had survived three monsoons. In Dehra Dun *Artemisia* starts growing in April and the flowerheads appear in June. These flowerheads drop off in July when the monsoon has settled and the plant shows, in general, a sickly appearance but starts giving new shoots and flowerheads as soon as the monsoon is over.

This records our observations but it is difficult to offer an explanation especially when the plant has been grown in a climate so different from that of its natural habitat. It is possible that if the monsoon were not so heavy (about 70 inches in July, August and September) the flowerheads formed in June would have opened in due course without being killed and a second flowerhead would not have been formed after the rains. Mr. Qazilbash cites the case of delayed flowering in hybrid forms of *Artemisia* which is interesting reading in this connection.

Bio-Chemist,
Forest Research Institute,
Dehra Dun, S. KRISHNA.
July 20, 1943.

REVIEWS

pH IN PRACTICE

Hydrogen Ions, Their Determination and Importance in Pure Industrial Chemistry. Vols. I and II. By H. T. S. Britton. (Monographs on Applied Chemistry Series). (Chapman and Hall, Ltd., London), 1942, Third Edition. Vol. I pp. xix + 420, price 36*sh.*; and Vol. II pp. xix + 443, price 36*sh.*

One of the significant developments in industrial control and practice in the last decade and more has been the rapidly increasing recognition of the important role played by pH in many of the methods of industrial processing. Such developments have obviously run hand in hand with the increasing necessity for automatic and precise controls in large-scale productions of high quality and uniformity at competitive prices. The field controlled by hydrogen ions ranges from such subjects as ceramics and soil fertility to a multitude of the more obvious practices such as Textile and Dye Industry, Water Purification, Corrosion, Sewage Disposal, Baking, Brewing, Pulp and Paper Manufacture, Tanning Processes, Sugar Manufacture, Methods of Electro-Deposition and, finally, the important subjects of analytical and separation methods in Inorganic Chemistry. Thus the production of satisfactory paper depends on the efficient adjustment of the hydrogen ion concentration of the liquors employed, and more particularly in the sizing operations, as this determines the final quality of the paper; printers often find that their types and plates deteriorate more rapidly when used on some papers than on others although all were purchased as being of the same quality. In the manufacture of sugar the careful regulation of acidity and alkalinity of the various sugar solutions during the purification process has always been a problem of paramount importance. The control of hydrogen ion concentration in textile processes is a matter of definite practical importance, more particularly in the wet processing of ampholytic substances silk and wool, and especially their dying. Developments in biochemical researches have shown that in order to secure or avoid the optimum activity of enzymes and bacteria, specific ranges of hydrogen ion concentrations have to be established. A striking example is the effect of the less extreme variations in hydrogen ion concentration in the soil, which modify the distribution and activity of its teeming population of micro-organisms besides affecting the condition of plant nutrition. This has also a bearing on the incidence and severity of many plant diseases. Other biochemical processes in which hydrogen ion concentration is a useful index are the control and execution of the different preliminary stages of leather manufacture, the methods of mashing, malting, brewing and fermentation, the preservation of milk and other dairy processes, the baking industry, sewage disposal, etc. As is well known the measure of hydrogen ion concentration is of fundamental importance in inorganic chemistry. Apart from the possibilities of potentiometric titrations, analytical and other processes involving precipitation of hydroxides and basic salts can be kept under perfect control by maintaining the appropriate pH value as indicated by colorimetric or electrometric methods. This specificity of pH for the precipitations of insoluble salts also underlies the need for a careful regulation of hydrogen ion concentration of the solutions from which certain basic metals such as nickel, cobalt, iron and manganese are cathodically deposited. The variations in the tanning properties of chrome solutions are in a similar way controlled by relations between pH and phenomena of "soluble basic salt" formation. It is interesting also to note how pH controls the simple and differential flotations of ores.

Prof. Britton's monograph is a storehouse of much valuable information on each of the topics briefly mentioned above and much else besides in the form of tables and graphs. The industrial applications are all considered in Volume II in a succession of chapters from XXII to XLVI. Volume I deals essentially with the several practical methods of pH measurement and control, leavened with just that amount of the fundamental theories of electrode potentials and behaviour of ions in solutions and ionisation constants, as will help to anchor the reader to the realities of his measurements. A new chapter XXI on Redox potentials makes up for a serious omission in the previous 1931 edition of this book. The reviewer is in agreement with the author in the limits set by him to the exposition of the theoretical concepts. This makes the book readable to the less initiated as well.

Altogether, this new edition is a very welcome publication and should be opportune to the large number of physical chemists who are now actively engaged in "essential war services". There is a 50 per cent. increase in the number of pages over the 1931 edition due to incorporation of new chapters and revision and substantial additions to old. This has obviously necessitated the split of the monograph into nearly equal volumes of more convenient size. It is, however, less obvious why the pages in second volume are numbered afresh while the figures and tables and chapters are all numbered in continuation of volume one. The printing and paper are of a high pre-war standard while the cost reflects the war-time conditions. This publication must find a place in every industrial and university library.

M. A. G. Rau.

Intermediate Practical Physics. By Prof. Vissa Appa Rao. (Andhra University Series No. 28, Waltair), 1942. Pp. viii + 337. Price Rs. 4.

It is a happy augury for the future that more and more science text-books are being produced in India, which can really be called text-books and are not merely "Notes" or "Cram" books. The present book is a good example of the excellent volumes that are now seeking

to supply the wants of Indian students and is apparently the handiwork of an experienced teacher. It gives a description of those experiments which constitute the course in practical Physics for the Intermediate Examination of Indian Universities, with fine model results set out for every experiment. A concise presentation of the underlying theory precedes the description of the experiment and it is surprising to see the amount of theory compressed into a short space in this way. The course of experiments is that common to most Indian Universities and the apparatus described is also mostly standard. The same absence of superfluous words characterises the description of the experiments, as was noticed in the presentation of the theory. Now and again a question is interposed with a 'why' or a (?) which serves to draw the student's attention to important points worth careful thought. The language is adequate and acceptable, barring a few slips here and there, such as 'compass' for 'compasses', 'a point "impressed by" forces' for 'a point "acted upon by" forces', 'slow motion "affected" with the help of a screw' for "effected", etc., 'small boats and "rafters"' for 'rafts', etc., the symbols ' and " for minutes and seconds of time instead of ^{m} and ^{s} and so on. There are a few wrong statements which require correction. For example, it is stated that as the elasticity of a fluid is independent of direction, the pressure at any point is communicated equally in all directions. In explaining the relative expansion of a liquid inside a flask, it is stated that a point on the neck coinciding with the initial level of the liquid changes position owing to the expansion of the vessel and thus prevents the full expansion of the liquid from being noticed. Surely it is not merely the motion of such a point of reference but the expansion of the whole vessel that affects the observed expansion of the liquid. The statement that "molecules have the same properties as the body, and any further subdivision of these destroys their characteristic physical properties" should be removed at the first opportunity. To say that "the incident rays, reflected rays and the normal are in the plane of the paper and this verifies the first law" is not correct; when only the marks left by the pins on the paper are joined, how has it been proved that the incident and reflected rays lie in the plane of the paper? We have indicated these errors only because we feel that the book is a good one which will certainly gain a well-deserved wide currency and we should like it to be as free as possible from such blemishes. A verification of the fact that a reflected ray turns through twice the angle through which the mirror turns, and of the lateral shift of the emergent ray in refraction through a slab may be included. The printing and get-up of the book leave nothing to be desired. We feel quite certain that the book will have a richly deserved popularity among Intermediate students all over the country, and we heartily recommend it to the attention of all teachers handling Intermediate Classes.

T. S. S.

Electric Power System Control. By H. P. Young. (Chapman and Hall), 1942. Pp. 319 + xii. Price 25*sh*.

This book is the eleventh volume of the series of monographs on electrical engineering subjects coming out under the editorship of Mr. H. P. Young.

In this book the author (Mr. Young himself) has succeeded in bringing together all the latest and important information on the subject of system control and presenting it in a coherent and readable form. It is, therefore, very useful to the power supply engineer who cannot afford the necessary time to go through the voluminous mass of available literature on the subject. To engineers in India who very often have no access to good technical libraries it must have an especial appeal. The advanced student of the subject also finds in it much that is of value to him.

The scheme of the book is as follows. There is an introductory chapter on the parallel operation of generators and characteristics of exciters. The two that follow deal with the various aspects of voltage control of alternators and describe the several auxiliaries employed for voltage regulation. We then have in another chapter a good description of the more important synchronising gears in use to-day. The next four contain a treatment of the various aspects of system design such as control of power transfer, circuit breakers and circuit interruption, short circuit calculation and protection, and all the other complex problems, theoretical and practical, arising out of the interconnection of large power stations. A description of the apparatus used for interconnector control is the content of the ninth chapter; while the last one deals briefly with the principles of the latest development of system control, that is, supervisory control systems.

The material for the book has thus been carefully selected and well arranged, and covers all the important aspects of system design. The information included under each topic is up-to-date. A short bibliography at the end of the book giving references to the more important publications on the subject adds to the value of this monograph.

The printing and get-up of the book are in the usual Chapman style. The few misprints that still persist will, the reviewer hopes, be removed in the next edition.

The book is in short a worthy companion to the preceding ten volumes of the series, and is confidently recommended to the profession.

S. KRISHNASWAMY.

Amaravati Sculptures in the Madras Museum. *Bulletin of the Madras Government Museum* (New Series, General Section, Vol. IV). By C. Sivarama Murthi. Pp. xviii + 376. Price Rs. 14-8-0.

One of the greatest attractions to the Madras Government Museum has been for long its fine Archæological Section. And in that collection, the portion of the Amaravati Sculptures lodged forms the gem. This monograph deals exhaustively yet comprehensively with the whole subject of the unique sculptures that come from near and about Amaravati in

the present Kistna District of the Madras Presidency. Dr. F. H. Gravely, until recently Superintendent of the Madras Government Museum, contributes an appreciative *Foreword*, in which he sets forth in modest terms the many undoubted merits of the work. In view of the fact that he appears to have had much to do with its publication, it seems appropriate that his approval of it should perhaps be referred to at some length. Having regard to limitations of space, however, it cannot more than be adverted to. Mr. Sivarama Murthi has spent much time and labour on his work and as Dr. Gravely rightly observes, has produced something more than a mere catalogue of the sculptures lodged in the Museum. He has brought to bear his knowledge of art on his work also, while his presentation of the history of the Satavahana period lights up certain of its dark corners. He has also enriched our knowledge of social history and manners and habits of the period while the contribution he makes to the problem of the origin of the indigenous form of the Buddha image is indeed suggestive to a degree. It is true a galaxy of stars of the first magnitude in the study of Buddhism have undoubtedly shed light on the subject of these sculptures and their interpretation—such, for instance, by Burgess, Foueber, Coomaraswamy, to mention but a few. What Mr. Sivarama Murthi has done will prove, however, of standing value both as a catalogue and a guide to the sculptures lodged in the Madras Museum and as a study of the architecture, history, culture and art of the period to which they belong. The inscriptions have been re-read and get their right place in the volume. The work, in view of the very solid study it offers of all that is known so far of the Amaravati sculptures in India or in the British Museum is a great contribution historically and linguistically. Mr. Sivarama Murthi deserves to be complimented on his splendid achievement, both as a lover of art and as a scholar anxious to do his bit to advance the study of a subject that has attracted, by virtue of the magnificence of the art with which it is associated such world-wide interest. The monograph, we should add, is illustrated by a number of drawings by the author and enriched by as many as five appendices devoted to relevant special topics. The general Index also deserves mention. This is altogether a volume that is bound to further research in India in many fields than one. As such it is likely to attract wide attention in archæological and art circles the world over, despite the devastating war, in which we are glad it has been found possible to issue it.

C. Hayavadana Rao.

SCIENCE NOTES AND NEWS

Treatment of Malaria: A Proved Substitute for Quinine.—In a country like India, where malaria takes such a large toll of life, as well as the energy and efficiency of the population, any shortage in the supply of quinine is naturally viewed with apprehension by the medical profession and public health authorities. Thus, it is good news indeed, to learn that a really effective substitute for quinine is being locally produced and that there is such sufficiency of raw materials as to enable the manufacturers to distribute no less than 14,000,000 tablets this year. The name is Laverain and it is manufactured from quinoidine the non-crystallizable alkaloids of cinchona bark.

Laverain is not new in the treatment of malaria, having been thoroughly tried for a number of years with most effective results. It has the advantages of being somewhat cheaper than quinine and of not producing certain of the undesirable after-effects, notably deafness. Under clinical tests there have been positively no cases of relapse. The news of the manufacture of Laverain on a bulk scale is welcome.

Manure from Town-Wastes.—The training course for Biochemists deputed by different Provinces and States in India in the improved process of preparing compost manure from town-wastes developed at Bangalore, was formally inaugurated at the Indian Institute of Science, Bangalore, on 4th August 1943. It may be recalled that the Government of India recently sanctioned a sum of nearly Rs. 2½ lakhs for a programme of large-scale preparation of compost manure from town-wastes, the scheme to be worked under the auspices of the Imperial Council of Agricultural Research. Dr. C. N. Acharya, Chief Biochemist, is in charge of the training scheme.

"Bubblefil".—A new rayon yarn called "bubblefil" has been developed by E. I. du Pont re Nemours and Company, Wilmington, Del., to replace kapok. According to the *Cordage World* of March 1943, Du Pont is turning out the "bubblefil" cellulose experimentally at the rate of about 200 pounds daily. The new material has buoyant and resilient qualities, making it a potential military substitute for kapok and sponge rubber, the entire supply at present going to the armed services for life rafts, aviators' cushions and possibly other uses.

The supply of kapok has been restricted by the War Production Board to military orders for life buoys, life preservers and jackets, sleeping bags, pontoon bridges, insulation padding for airplanes and a few other specified uses.

New Hydro-Electric Scheme for Madras and Orissa.—Preliminary investigations and surveys for developing hydro-electric power by utilising the Duduna falls of the Machkand river (a tributary of the River Sabari which

in turn empties into the River Godavari) are in progress.

The scheme area is on the boundary line between the Madras and Orissa Provinces, it is located at about 82° 30′ N. Lat., and when developed will serve both these provinces.

The area of the basin above the falls is about 860 sq. miles and the mean annual rainfall in the basin is 55 inches. The country is at an altitude above 2,600 M.S.L. and is covered by forest varying in density from thick woods at higher altitudes to scrub jungle in the lower reaches. For the purpose of design in the absence of reliable data the mean annual run off is taken as about 25′.

The natural minimum continuous run off in the stream at the site of scheme is about 100 cusecs and with a storage reservoir of 16,000 Mcft. at Jalaput, seventeen miles higher up the river, continuous power draft of 840 cusecs is possible. The gross head available is about 850′ and it lies between contours 2·550′ and 1·600′ M.S.L. Thus a continuous power of about 48,000 K.W. is possible.

Preliminary estimates show that the scheme is likely to cost about Rs. 2·25 crores and would be remunerative.

The survey and preliminary designs would be finished before 1944 and would be kept ready for execution as soon as the war is over.

The Imperial Institute, London.—Extensive facilities are available at the Imperial Institute, London, for the rapid supply of technical information relating to the trade, occurrence and utilization throughout the world of all kinds of raw materials, but the scope of the intelligence service is not sc well known as it should be. The Institute's staff includes tropical agriculturists, chemists, chemical technologists, economic botanists, economic geologists, mining engineers, mineralogists and statisticians, and, when required, the Institute seeks the advice of members of its fifteen consultative committees. Further help is also afforded by numerous trade contacts. The Institute also has an extensive reference library and a technical index covering most of the relevant trade and scientific pubiications issued during the past thirty years. The Institute can deal with inquiries relating to sources of supply of, and other information relating to, raw materials and semi-manufactured products whether of animal, plant or mineral origin in all countries, cultivation of crops and the soil and conditions under which they have to be grown, methods employed in mining, smelting and dressing minerals for the market, and so on. Analysis and testing of samples of raw materials is undertaken in the laboratories of the Institute. Inquiries should be made in the first instance to the Intelligence Section of the Plant and Animal Products Department or of the Mineral Resources Department, according to the nature of the subject concerned. No charge is made for services to departments of the United Kingdom Government or other Governments of the Empire contributing to the general funds of the Institute unless a particular inquiry involves a volume of work so great that it cannot be undertaken by the existing staff.

The Institute of Chemistry.—*Nature* reports that His Majesty the King has been pleased to command that the Institute of Chemistry shall henceforth be known as "The Royal Institute of Chemistry of Great Britain and Ireland".

Indian Chemical Industries.—"In India, a chemical industry based on petroleum, sugar and calcium carbide might prove to be far more economical than one based upon coal tar. Development on these lines will necessarily involve much fundamental research and may appear to be speculative at the present time, but it seems to be more likely to lead to success than one based on older and well-established methods. It would certainly be profitable for the younger chemists now being trained in India to devote some of their energy and skill to a consideration of these problems. A further large field for research is to be found in the development of India's reserves of cellulose. In Sweden the exigencies of war have emphasised how very valuable a raw material this is. In the post-war years, we may anticipate that India will lead in this and in other fields of technical research."—(*Nature*, 1943, 151, 412.)

Indo-China Cultural Study Scheme.—A Selection Board consisting of Sir Maurice Gwyer, former Chief Justice of India, and Mr. John Sargent, Educational Commissioner with the Government of India, has selected ten Indian students who will proceed to China for research work at Chinese Universities under the Indo-China Cultural Study Scheme. A batch of ten Chinese students is expected in India by the end of this month for a similar object.

Research Schemes.—The Government of Madras have sanctioned the following schemes: Research on Insects Occurring in Stored Oil Seeds (particularly groundnuts), at a cost of Rs. 4,300 for one year (Rs. 3,225 has been granted by the Imperial Council of Agricultural Research); Research on Pests and Diseases of Groundnuts, costing Rs. 10,907 for two years (the Imperial Council's contribution being Rs. 8,181); and Research on the Storage of Groundnuts, at a cost of Rs. 1,24,040 for three years (the Imperial Council's contribution being Rs. 62,000).

Seven Lakhs for Research.—At a recent meeting of the Bombay University Senate it was announced that Sir Homi Mehta had donated Rs. 7 lakhs to the University to be utilised for research in chemistry in connection with the Technological Department of the University.

Nagpur University.—Sir Mirza M. Ismail, Prime Minister of Jaipur, in the course of his Convocation Address to the University of Nagpur, said: "With victory and peace will come a new era for our country, an era of perfect freedom, with such industrial opportunity as she has never known before. The graduates of to-day will spend their lives in a totally new world with social, economic and political problems of a complexity corresponding to their

richness in opportunity. It is for our university men to solve these problems, in patient thought, and in really unselfish and patriotic world.

"This country can become one of the most powerful and influential in the world, if only she uses her resources and energies aright. I think the great danger is that we may spend much of our force in conflict with each other. Whatever form our free Constitution is to take, we—especially we who have, in a university, been trained in a certain self-discipline of thought, feeling and behaviour—should, undoubtedly, be leaders in moderation, mutual understanding, and respect, and in a new and practical policy of political and social compromise."

Industrialisation of Travancore.—Sir C. P. Ramaswami Ayyar, the Dewan, presiding at the session of the Sri Chitra Council, dwelt on the major activities of the nation-building departments. Under industries, he described the immense potentialities of the ship-building industry. The Government had under consideration the development of coastal shipping, and had enlisted the assistance of all-India export businessmen actually engaged in coastal shipping service. Part of the scheme was to co-ordinate back-water traffic with the coastal service. This led to the need to develop a ship-building industry. He then mentioned other major industries largely connected with the production of food and clothing, specially the chemical and fertiliser industries. He drew attention to the natural advantages the country possessed by way of raw materials and the by-products of existing industries. A heavy chemical industry would soon be started.

MAGNETIC NOTES

Magnetic conditions during July 1943 were slightly more disturbed than in the previous month. There were 8 *quiet* days and 23 days of *slight* disturbance as against 14 quiet days, 16 days of slight disturbance and one of moderate disturbance during July of last year.

The quietest day during July 1943 was the 14th and the day of largest disturbance was the 5th.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days — Slight
1, 2, 14, 20, 23, 24, 28, 29	3–13, 15–19, 21, 22, 25–27, 30, 31

No magnetic storm occurred during the month of July in the years 1942 and 1943.

The mean character figure for the month of July 1943 was 0·74 as against 0·58 for July of last year.

M. V. SIVARAMAKRISHNAN.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory, Bombay, during the month of July 1943, there were two of moderate and one of slight intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin (I.S.T.)	Epicentral distance from Bombay	Co-ordinates of epicentre (tentative)	Depth of focus
		H. M.	(Miles)		(Miles)
15	Slight	18 22	1840		
23	Moderate	21 23	3200	Lat. 7°·5 S., Long. 113° E., near Java.	60
29	Moderate	09 32	8660		

We acknowledge with thanks the receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 91, Nos. 4637, 4638 and 4640.

"Journal of Agricultural Research," Vol. 66, No. 4.

"Agricultural Gazette of New South Wales," Vol. 54, Pt. 5.

"Indian Journal of Agricultural Science," Vol. 13, Pt. 2.

"Biological Reviews," Vol. 18, No. 2.

"Journal of the Indian Botanical Society," Vol. 22, Nos. 2, 3 and 4.

"Journal of the Indian Chemical Society," Vol. 20, No. 6.

"Journal of Chemical Physics," Vol. 11, Nos. 3-4.

"Chemical Products and Chemical News," Vol. 6, Nos. 5-6.

"Indian Farming," Vol. 4, No. 4.

"Transactions of the Faraday Society," Vol. 39, Pt. 6.

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An Introduction to Pure Solid Geometry. By G. S. Mahajani. (Mr. Vithal Hari Barve, Aryabhushan Press, Poona), 1943. Pp. iii + 104. Price Rs. 3.

The Cathode Ray Oscillograph in Industry. By W. Wilson. (Chapman and Hall, Ltd., London), 1943. Pp. xii + 150. Price 12*sh.* 6*d.*

Spectrophotometry in Medicine. By Ludwig Heilmeyer. (Adam Hilger Ltd., London), 1943. Pp. xiv + 280. Price 30*sh.*, postage 9*d.*

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Proposed Purchasing Specifications for Pure Lac for Electrical Insulating Purposes (Technical Report No. A/S49). (The British Electrical and Allied Industries Research Association, London), 1938. Pp. 14 + 2. Price 1/6*d.*

An Introduction to Historical Plant Geography. By E. V. Wulff. (Waltham, Mass: The Chronica Botanica Co.; Calcutta: Macmillan & Co., Ltd.), 1942. Pp. xv + 223. Price $4.75.

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CURRENT SCIENCE

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PLANT BREEDING IN RELATION TO FOOD PRODUCTION

INDIA has never been a surplus country with regard to her food grains. The population has been increasing by nearly ten per cent. every ten years but the production has not kept pace with this increase in population. The normal small exports of the country are more than counterbalanced by imports from outside. It has to be remembered in this connection that the statistics of production figures available in the country, are hardly reliable and ways and means of obtaining more accurate figures for production, are still under investigation.

The chief food grains of the country are, in the order of their importance, rice, wheat and millets (including jowar). Of the above, wheat is a cold weather crop grown under irrigation in Northern India,—Sind, Punjab, U.P. and Bihar—and as a rain-fed crop chiefly in the black cotton soils of peninsular India. A large part of the area under millets is also confined to the black cotton soils of peninsular India and in several cases, the success of the crop depends upon a good and well distributed monsoon. In contrast with the above two, rice production is associated with a more plentiful supply of water either in the shape of monsoon rains or special irrigation systems. The rice area is mainly confined to East India,—Assam, Bengal, Bihar, Orissa, C.P., Madras and the narrow belt of land on the west lying between the Arabian Sea and the Western Ghats. Since rice forms the staple food of a large majority of the Indian population, it is the production of this crop that determines the deficit or surplus position of the country with regard to its food requirements. Even in years when the deficit was considerable it did not cause any anxiety so long as there was Burma nearby with a large exportable surplus of the commodity. Time there was, not at a very distant date, when with the prospect of getting rice cheaply from Burma where the cost of production is comparatively cheaper than in India, the question of actually reducing the area under rice in favour of industrial crops was even thought of. In fact, the question was seriously considered at a Crop Planning Conference held under the auspices of the Imperial Council of Agricultural Research nearly ten years back. The idea was, however, dropped due to the opposition from certain provinces where, under the system of rice cultivation practised in concentrated areas, there was not much scope to introduce alternative crops. The present war and the loss of Burma has brought home the danger of depending upon foreign imports for the most important food grain of the country. For a large country like India with an enormous and ever-increasing population and where, over a large part, the success of crop production depends upon the vicissitudes of the monsoon, it is necessary that the country should be made as self-sufficient as possible for its food requirements. It is very unlikely that after the cessation of the war the question of over-production of food crops will cause difficulties, and even if it should, the proper course would be to absorb the surplus in industrial concerns.

The immediate and pressing problem is to increase the production of food crops. To attempt this, two ways are open to us:

(*i*) Increasing the acre yields in the existing areas by (*a*) substituting ordinary varieties grown by the cultivators by the improved ones evolved by the plant breeders and (*b*) by adopting intensive manuring practices.

(*ii*) Increasing the area under food crops by (*a*) either designing new irrigation systems or making adjustments in the existing irrigation projects and (*b*) substituting areas under non-food crops with food crops.

Improved Varieties as a Means of Increasing Acre Yields

It is well recognised that successful plant breeding work by itself can improve the production by at least ten per cent. If the existing varieties are systematically replaced by improved ones by well-planned seed multiplication and distribution schemes. Growing an improved variety costs the cultivator no additional expenditure and no difficulty has been experienced anywhere about the cultivator being unwilling to take up the improved variety. It is sometimes pointed out that in spite of the fact that plant breeders have been working for several years and producing new varieties, the area in the country under such improved varieties, forms only a small fraction of the total area under the respective crops. This may partly be due to want of experimental data obtained by extensive trials in cultivators' fields to decide upon the superiority of the improved kinds for particular areas. But even where such data are available, that the area under improved varieties has not increased, is mainly due to the aversion of Provincial Governments to finance seed distribution schemes. Punjab is, however, an exception where large amounts are spent annually on seed distribution schemes, and when once the superiority of an improved variety is established, seed schemes are immediately put into operation. It may be pointed out that seed schemes are by no means a net expenditure to the Provincial Government and that well-planned schemes can actually be made self-supporting. The exigencies of war and the shortage of food, have now made the Provincial Governments realise the importance of supplying pure seed to the cultivators as a sure and easy means of augmenting production and several governments have now provided liberal grants for seed schemes. This work should be extended by every possible means wherever improved varieties found suitable to particular tracts, are already available. It might happen that some of the varieties with the breeder may require further testing out in cultivators' fields and this could be undertaken immediately. Due to differences in the intensity of breeding work carried out in the various provinces, some might be more favourably situated than others with regard to the availability of improved varieties for different tracts. For example, in Madras it should be possible to recommend improved varieties for all the major rice tracts of the province.

Intensive Manuring as a Means of Increasing Acre Yields

Apart from water being a general limiting factor for crop outturn, it has an indirect relationship to manuring practices. In crops like rain-fed wheats and millets there is probably not much scope of increasing acre yields by manuring as an emergency measure. The fertility here has to be gradually built up by a continuous application of cattle manure or composts. Irrigated wheats, however, come under a different category and increasing their acre yields by manuring should be possible. There are indications of oil cakes in C.P. and ammonium sulphate in Punjab giving profitable increases in yield. But we have no extensive experimental data to go by to make immediate recommendations. The available information about rice manuring is happily much more definite. Ammonium sulphate, oil cakes and green manuring are all known to give profitable increase in yields in several areas.

Due to war conditions ammonium sulphate is not available in quantities nor at remunerative rates. It has been suggested recently that the resolution of the United Nations Food Conference "that Governments which need fertilisers should be supplied with them subject to the exigencies of war", might be given effect to. If it is possible to import the necessary machinery to manufacture sufficient ammonium sulphate in the country, it should help in increasing rice production immediately. That acre yields of rice in other countries are much higher than in India is due to the fact that the soils there are not only more inherently fertile than in India but also receive fertilisers to the extent of 70-100 lbs. of N. per acre whereas in India, the majority of the rice lands do not get any manure at all. It has been shown that in parts of Madras, acre yields comparable to the foreign countries could be obtained with intensive manuring. With regard to oil cakes the areas where rice is cultivated extensively are not those where oil seed crops come in the cropping and making oil cakes available to the cultivators at remunerative rates appears to be a question of overcoming transport difficulties. Lastly, wherever rice is grown in India, any form of green manuring has always proved profitable. Besides green manuring other bulky manures like composts, municipal wastes, etc., are also useful for rice and the use of these should be encouraged by every possible means.

It has to be mentioned, however, that it will not be enough if the use of either improved seed or manures is simply recommended; they should actually be made available at every rural centre at reasonable prices. It may be mentioned here that the general experience has been that the improved varieties respond better to intensive manuring than unselected kinds. There is no doubt that the growing of improved varieties coupled with intensive

methods of cultivation, particularly manuring, wherever possible, should soon make the country self-sufficient with regard to the country's requirements of rice.

Increasing the Crop Area by either Designing of New Irrigation Projects or Adjusting the Present Ones

Starting of fresh irrigation projects to bring new areas under food crops though it involves capital expenditure is a sure way of increasing food production. The recent appointment of a special irrigation adviser with the Government of India, is a move in the right direction. It would probably be worth while to put an irrigation engineer on special duty in each of the provinces where irrigated rice is an important crop. The possibilities of starting new minor projects or improving such of the old ones that have gone out of use would receive adequate attention in that case. The examination of improving irrigation facilities should particularly be welcome in provinces like Bengal and Bihar where, in spite of their large areas, the acre yields are comparatively low mainly for the reason that in a greater portion of their rice areas there is scarcity of water at critical periods of plant growth though there may be a surfeit of it at other times. Minor adjustments in the existing irrigation systems might help in increasing the area under the crop. For instance, where a single crop of about five months duration is at present grown, it should be possible to grow two short-duration crops in quick succession in the same season. Similarly in tracts where both single crop and double crop areas exist, and where the latter form only a small fraction of the total area, the percentage of the double crop area could be increased by adjusting the time of opening and closing of the irrigation channels. This last suggestion is already being given effect to in parts of Madras.

While considering irrigation projects the question of the large inundated areas on the seacoast in Bengal, Orissa, parts of Madras and Bombay where rice is at present a very precarious crop may also be thought of. While breeders may be expected to recommend as a result of research, varieties that could withstand flooding or a slight salinity in the water, making the area safe for rice cultivation is essentially an engineering problem. It might mean considerable capital expenditure but still it is a problem worth investigating from the view-point of the ultimate increase in the food production of the country.

The success of either new projects or improvements in the existing ones will depend to a large extent on the right choice of the varieties to be grown. The breeder with local experience should be able to give the necessary advice, and in any case, it is necessary that the irrigation authorities should work in close collaboration with the breeder.

In the attempt to bring more area under food crops the large areas shown as uncultivated wastes in the revenue statistics of *ryotwari* provinces could be thought of. In several causes such areas may not actually be cultivable for various reasons such as, rocky or poor nature of the soil, absence of water facilities, absence of people in the locality being unhealthy spots, etc. The immediate necessity is to make a proper survey of these areas with a view to determine what portions of such areas could be brought under crops and what facilities they would need. There are also the broad strips of waste land lying on either side of railway lines. A good portion of them is capable of growing food crops and the question is to determine whereall it could be done without endangering the safety of the permanent ways.

Substituting Non-Food Crops by Food Crops

The scope for this appears to lie mainly in the rain-fed tracts. The only crop that can be replaced by food crops is the short staple cotton and while considerable progress has already been made in this direction in parts of C.P. and Hyderabad its success would appear to depend upon the cultivator being compensated in cash for the change-over as the growing of short staple cotton still brings him a greater return than the food crops. In irrigated lands where the non-food crops that are chiefly grown are cotton and sugarcane, the disparity in the returns between food and non-food crops even at the present rate of food grains is greater than in the rain-fed tracts, and to induce cultivators to go in for food crops might prove impracticable unless they are going to be sufficiently compensated.

Post-War Problem of Food Production

So far we have discussed the question of increasing food production as an emergency measure. Equally, if not more important, is the question of making the country self-sufficient with regard to food requirements even in the post-war period so that we shall never again find ourselves placed in a difficult situation like the present one. It has been already stated that successful plant breeding and production of improved varieties is a sure and the least expensive method of improving the acre outturns. Any expenditure on plant breeding work should give returns several fold. It is, in fact, the results of plant breeding work that form the chief plank on which most of the activities of the provincial agricultural departments depend. We shall now examine the scope and position of plant breeding work in the country with regard to the three chief food crops.

Wheat was the first crop to receive attention at the hands of Sir Albert Howard and his improved varieties had spread all over India, particularly Northern India, and outside India as well. The breeding work in this crop is now being carried on by the Imperial Economic Botanist at the Imperial Agricultural Research Institute, New Delhi. Some of the wheats bred at Delhi are expected to be found suitable for parts of U.P. and Bihar. Punjab has its own wheat botanist and certain new varieties bred by him have completely replaced Howard's wheats in the province. The wheats grown in Sind are either those of Pusa or of the Punjab. So far as peninsular India is concerned where a different wheat (*durum*) is grown, the

problem is separate and has to be dealt with independently. Work on this wheat is going on in Bombay, C.P., Hyderabad (Dn.) and Indore. Apart from the two main divisions, the irrigated bread wheats of N. India and rain-fed *durum* wheats of peninsular India, there is a fair amount of adaptability within the two groups. Wheats bred at one centre may do equally well at another. This should not be taken to mean, however, that the breeding work could be sufficiently centralised. It is quite likely that if independent and intensive breeding schemes are carried out in U.P. or Bihar, there should become available varieties even better than either Howard's wheats or the new wheats bred at Delhi. There are always bound to be local differences and adaptations of the crop to such differences.

With regard to millets which are of comparatively greater importance to peninsular India, work has been going on in Madras, Bombay, C.P., Hyderabad, Mysore, Indore, etc., but from the results available it would appear there is considerable scope for further intensification of the work. Breeding in millets is comparatively a more difficult task as the failure or an uneven distribution of the monsoon might easily upset the whole programme of work. The importance of the work on some of the minor millets has been recognised recently and breeding schemes have now been started in several provinces and States with finance partly provided by the Imperial Council of Agricultural Research.

Coming to rice, each of the rice provinces has now got either a whole-time or part-time plant breeder and the Imperial Council of Agricultural Research has been responsible for intensifying this work in some of the provinces with liberally provided finance during the last ten years. There are several improved varieties evolved by the breeders in the chief rice provinces already available with which seed schemes are in progress. One thing that has to be emphasised in the case of rice is that it has a limited adaptability, and it is within the experience of breeders that improved varieties from another province or even from a different tract within the same province have often proved failures. Work for each tract has to be done independently and the ideal arrangement should be to have as many breeding stations as the number of individual tracts with varying conditions warrant. Madras might probably be mentioned as an example of having adopted this policy. The paucity of sufficient number of stations should make it apparent how much yet remains to be done, for example, in a predominantly rice province like Bengal.

Scope of Plant Breeding Science

There is no doubt that to carry out breeding work more thoroughly and more intensively for a country of the size of India, we shall require several more trained plant breeders and breeding stations than what we have at present. The magnitude of the work needs no emphasis. Varieties superior to what is commonly grown by the cultivators have to be evolved for millions of acres on which unselected mixed types still continue to be grown. Plant breeding involves not only production of varieties with greater yields but also varieties that could resist pests, diseases, drought, salinity in the soil or water, etc. The time is past when plant breeding was considered more an art than a science. Plant breeding science touches in its sphere of activities several branches of botanical science, like taxonomy, genetics, cytology, pathology, physiology, etc. Great advances have taken place in recent days in these branches of science and proficiency in any or all of these cannot alone make a successful plant breeder. A breeder to be successful should not only know something of these sciences but also keep abreast of the latest developments and utilise them as tools in his own sphere of work. His work consists mainly in the field, making continuous observations on the growing plant and sifting the variable material. Besides the above sciences, statistics has come to play an ever-increasing part in giving a precision and objectiveness in the technique of breeding. It has partly dispensed with the trial and error methods of earlier plant breeders and no plant breeder worth the name can afford to neglect statistics.

While it is true that the practical achievements of plant breeding research in India would compare very favourably with any of the more advanced countries of the world, it has yet to be admitted that the number of successful breeders available in the country is hardly commensurate with the immensity of the problem. In India where the work is still in its infancy it is quite an easy matter to produce an improvement from the widely variable natural material available, but it cannot be said that the technique adopted in the difficult centres is not capable of being improved upon. Faulty technique is bound to cause delay in obtaining of successful results and this, a comparatively poor country like India, cannot afford.

Training of Plant Breeders

What are the facilities available in the country of the size of India to turn out plant breeders of the required calibre? The only countries with which India can be compared in this respect are Russia and U.S.A. and such a comparison immediately brings out the very poor position of India both with regard to training centres and the personnel capable of giving the necessary training. The tremendous advance Russia had made just before the present war started with regard to increasing the production of its raw products including food grains was achieved, not by tinkering with the problem, but by creating an army of trained men and distributing them for work throughout the length and breadth of the country. In India, besides the Imperial Department of Agricultural Research at New Delhi, the provincial departments of agriculture have their own Crop Specialists or Economic Botanists to deal with the problem of improvement of crops. The staff under these experts consist of men who possess a University degree either in Botany or Agriculture and they start learning work only after they join the department; the

training thus obtained might not be all that is desired. No provincial agricultural college has got a definite post-graduate training scheme.

In U.S.A., besides the workers in individual States either on Government employment or attached to the Universities, there is the federal Government which has also a large agricultural department with a team of research workers and there are schemes directly under their control not only at federal headquarters but also scattered in the different States to supplement the work which the individual States might already be doing. The Imperial Council of Agricultural Research in India no doubt functions to a certain extent on the model of the federal department of agriculture in U.S.A. but it has not got the expert technical personnel to help or give guidance to workers in individual provinces or States. This is a matter that requires consideration from the point of view of all-India interest. Apart from other considerations, it will be well if the Imperial Council of Agricultural Research could examine at least the question of providing for the country competent personnel in sufficient numbers with sound training in plant breeding. It is quite likely that at least some of the agricultural research centres already existing in the country could be utilised as training centres with additional facilities provided wherever found necessary.

In conclusion, it may be definitely stated that plant breeding research offers the greatest scope for increasing the food production of the country not only as an emergency measure under the present conditions but also as a long-range measure in the post-war period.

PROF. H. J. BHABHA, F.R.S.

PROF. H. J. BHABHA, F.R.S., has been awarded the Adams Prize for 1941-42 by the University of Cambridge. Readers of *Current Science* will rejoice to learn that Prof. Bhabha is the first Indian to win this unique distinction.

The Adams Prize, valued at about £300, is awarded every even year for the best essay on some subject pertaining to pure mathematics, astronomy or some other branch of natural philosophy. Any person, who has at any time been admitted to a degree in the University of Cambridge, can compete for this coveted Prize, which is looked upon as one of the highest distinctions for distinguished scholarship and exceptional ability at exposition by all research workers. Quite often the award of the Prize could not be made for want of recipients as the standard set is extremely high. Between 1850 and 1913 this Prize was awarded only fifteen times! The list of Adams Prize winners includes the names of some of the greatest scientists of England, *viz.*, Maxwell, J. J. Thomson, Poynting, Larmor, Love, McLarin, Jeans and Fowler.

The subject of the essay for which Professor Bhabha was awarded the Prize was "The theory of elementary physical particles and their interactions". Prof. Bhabha is among the world's foremost workers in this field and has made many original contributions of fundamental importance to this subject during the last few years. Prof. Bhabha's presidential address to the Physics Section of the Indian Science Congress at its last session, was on the same subject and, in that address, he has indicated some of his ideas on the latest developments of the subject very clearly. This address was the subject of an excellent article by Sir Ralph Fowler, F.R.S., in the *Nature* of 5th June 1943.

Prof. Bhabha, at the moment, is engaged in writing a book on this subject, to be published by the Oxford University Press, and the Adams Prize essay forms only a part of the volume. We have no doubt this book will be most welcome as it will be the first systematic and logical development of the modern theory of the elementary particles of nature.

We offer our heartiest congratulations to Prof. Bhabha on this occasion. He is still in his early thirties and we wish him many long years of eventful research and greater distinctions to crown his scientific endeavours.

CO-ORDINATION OF RESEARCH IN UNIVERSITIES

DELIVERING the inaugural address of the Madras University Research Scholars' Association, Sir C. P. Ramaswami Ayyar, Dewan of Travancore, appealed to universities in South India to pool their resources and co-ordinate research work. The universities could sit together, confer together on their work so that there might be an interchange of students and professors and to avoid duplication and competition in the future. He would be a false prophet who forecast that, at the close of the war, there was going to be the best possible world ushered in. The post-war world would be a ruthless competitive world.

There was everywhere a great deal of talk about international gatherings and a considerable amount of research devoted to the new order of things. Whatever might result from such efforts there was no gainsaying that India would have to establish her industries and commerce not in a world of peace but in a world in which other countries, which were better able to produce and sell, would compete with her.

Unless India was abreast of the industrial nations of the world, she would be swept off by the current. It was from this point of view that they, in Travancore, had planned research schemes in their university.

STUDIES ON THE PRESERVATION OF GLANDS

I. The Preservation of Adrenal Glands

By B. B. DEY, P. S. KRISHNAN and V. SRINIVASAN
(Presidency College, Madras)

A CENTRAL factory in our country for the large-scale production of gland products can be thought of only when we solve the problem of storage and transport of the glands. It is a well-known fact that the gland tissue suffers autolysis with simultaneous destruction of hormonal activity unless proper precautions are taken to preserve these glands. Three methods suggest themselves for the proper preservation of glands: (1) The use of low temperatures, which will arrest enzyme activity—an entirely physical method, (2) use of chemical preservatives which inhibit bacterial action and (3) a combination of both.

The present investigation concerns itself with the changes in the adrenaline and vitamin C contents of the adrenal glands stored under various conditions. The methods employed for the estimation of adrenaline and vitamin C have already been described elsewhere (Dey, Krishnan and Srinivasan[1]). In all cases, unless otherwise stated, the glands after collection from the slaughtered animals, were transported to the laboratory packed in melting ice. The glands were kept for varying periods at different temperatures: (*i*) room temperature (30°–32° C.), (*ii*) Frigidaire temperature (3°–5° C.), (*iii*) in the frozen condition, the freezing being effected either by placing in the freezing chamber of the Frigidaire (a temp. of − 7° C.) or by packing in solid carbon dioxide (− 30° C.). In the first two cases a few drops of toluene were added as preservative. In a separate series of experiments (No. V in Tables I and II), the estimations were carried out on glands without the addition of toluene. Investigations were also carried out on the changes in the adrenaline content of glands which were stored in alcohol at room temperature for a period of one week. The values given in the following tables represent the mean of a series of estimations.

It has already been indicated (*loc. cit.*) that greater reliance has to be placed on the persulphate colorimetric method and the indophenol titration method for the accurate estimation of adrenaline and ascorbic acid respectively. As is obvious from Tables I and II,

TABLE I
Cattle glands (whole)

Method of storage	Period of storage	Adrenaline: Weight (mg.) per gram of gland — Folin	Adrenaline: Weight (mg.) per gram of gland — Persulphate	Vitamin C: Weight (mg.) per gram of gland — Indicator	Vitamin C: Weight (mg.) per gram of gland — Iodine
(i) Fresh glands transported to the laboratory in melting ice	2–3 hours after death of animal	3·05	1·85	0·91	1·09
(ii) Freezing with "dry ice" ..	2 days	3·05	1·73	0·89	1·15
(iii) Freezing in the Frigidaire ..	24 hours	2·74	1·72	0·80	1·09
	3 days	2·56	1·73	0·79	1·11
	7 days	2·63	1·58	0·65	0·99
	14 days	2·36	1·52	0·66	0·94
	1 month	2·55	1·59	0·77	1·11
(iv) Keeping at Frigidaire temperature with a few drops of toluene	24 hours	2·69	1·73	0·93	1·26
	2 days	2·68	1·68	0·69	0·98
	3 days	2·66	1·64	0·72	0·96
	4 days Putrefaction sets in	2·70	1·30	0·21	0·37
(v) Keeping at Frigidaire temperature without toluene	24 hours	3·13	1·75	0·98	1·32
	2 days Putrefaction sets in	2·44	1·59	0·85	1·18
(vi) Keeping at room temperature with a few drops of toluene	16 hours Putrefaction sets in	3·16	1·66	0·70	0·94
(vii) Preservation in alcohol	8 days	2·03	1·65	0·08	0·12

TABLE II

Sheep glands (whole)

Method of storage	Period of storage	Adrenaline: Weight (mg.) per gram of gland		Vitamin C: Weight (mg.) per gram of gland	
		Folin	Persulphate	Indicator	Iodine
(i) Fresh glands transported to the laboratory in melting ice	2–3 hours after death of animal	2·54	1·57	1·30	1·73
(ii) Freezing with "dry ice" ..	2 days	1·81	1·07	1·09	1·49
(iii) Freezing in the Frigidaire ..	24 hours	1·79	1·06	0·97	1·48
	3 days	1·92	1·06	0·98	1·40
	7 days	1·88	0·90	0·96	1·41
	14 days	1·87	0·88	0·92	1·32
	1 month	2·02	0·69	0·94	1·26
(iv) Keeping at Frigidaire temperature with a few drops of toluene	24 hours	2·40	1·18	1·03	1·45
	2 days	2·01	1·01	0·82	1·10
	3 days Putrefaction sets in	1·96	0·78	0·62	1·03
(v) Keeping at Frigidaire temperature without toluene	24 hours	1·82	1·03	1·19	1·60
	2 days Putrefaction sets in	1·64	0·65	0·95	1·28
(vi) Keeping at room temperature with a few drops of toluene	16 hours Putrefaction sets in	1·61	0·90	0·82	1·17
(vii) Preservation in alcohol	7 days	1·37	1·44	0·016	0·027

sheep glands, as a rule, suffer greater decomposition in adrenaline and vitamin C than cattle glands, stored under identical conditions, due probably to the softer texture of the former. Glands in the frozen condition can be stored without undergoing deterioration for several weeks. At the end of one month, the loss of adrenaline (as estimated by the specific persulphate oxidation reaction) is only about 15 per cent. in the case of cattle glands. In the case of sheep glands, however, the decomposition of adrenaline under these conditions is extensive (more than 50 per cent.). The analyses of adrenal glands, both cattle and sheep, frozen for 2 to 3 days either with CO_2 snow or by placing in the freezing chamber, show that the loss of adrenaline is not very appreciable. At the frigidaire temperature of 3 to 5° C., with toluene as preservative, the glands keep well for 2 to 3 days, the loss in adrenaline being only about 15 per cent., after which time putrefaction sets in. If no toluene is added the glands putrefy some 24 hours earlier. Kept at laboratory temperature, with a few drops of toluene, the glands develop smell in 12 to 18 hours' time, although adrenaline, as estimated by the persulphate method, does not suffer any serious loss. In all the above cases vitamin C also showed progressive decomposition although no definite correlation is apparent between the relative destruction of the adrenaline and the vitamin. Preservation of glands in alcohol is very effective; at the end of one week the loss of adrenaline in the case of cattle glands is 11 per cent. and in the case of sheep glands 8 per cent. Vitamin C, however, suffers extensive destruction under these conditions.

Much stress is often laid on the post-mortem diffusion of adrenaline from the medulla into the cortex. The glands which were frozen for one month, were then dissected carefully, and the medulla and cortex assayed separately for the adrenaline and vitamin C contents. The figures in Tables III and IV show that the medulla contains 63 and 71 per cent. of the total adrenaline in the case of the cattle and sheep glands respectively, as compared with 82 per cent. in the case of the fresh glands, showing thereby that a certain amount of diffusion has taken place.

In still another series of investigations (Table V) the glands, soon after collection from the slaughtered animals, were chilled by dropping into 'dry ice' and transported in this condition from the slaughter house to the laboratory, where they were immediately worked up. The values so obtained (*vide* Table V) show

TABLE III

Cattle glands (dissected)

Method of preservation	Adrenaline				Vitamin C			
	Weight (mg.) per gram of tissue				Weight (mg.) per gram of tissue			
	Medulla		Cortex		Medulla		Cortex	
	Folin	Persulphate	Folin	Persulphate	Indicator	Iodine	Indicator	Iodine
(i) Fresh glands ..	6·57	4·8	1·27	0·37	0·93	1·33	1·06	1·38
(ii) After freezing in the Frigidaire for one month	5·72	3·80	1·86	0·86	0·83	1·17	0·43	0·80

TABLE IV

Sheep glands (dissected)

Method of preservation	Adrenaline				Vitamin C			
	Weight (mg.) per gram of tissue				Weight (mg.) per gram of tissue			
	Medulla		Cortex		Medulla		Cortex	
	Folin	Persulphate	Folin	Persulphate	Indicator	Iodine	Indicator	Iodine
(i) Fresh glands ..	6·50	5·52	1·17	0·31	0·99	1·46	1·45	1·87
(ii) After freezing in the Frigidaire for one month	2·80	2·21	1·45	0·20	0·54	0·88	0·45	0·68

TABLE V

Instantaneous chilling of the glands with solid carbon dioxide

Animal	Adrenaline		Vitamin C	
	Weight (mg.) per gram of gland		Weight (mg.) per gram of gland	
	Folin	Persulphate	Indicator	Iodine
(i) Cattle	3·71	2·24	1·24	1·65
(ii) Sheep	2·52	1·60	1·36	1·71

a definite increase for both adrenaline and vitamin C, over those obtained for glands transported to the laboratory in melting ice.

A detailed discussion and interpretation of the results obtained will be published elsewhere. It is apparent, however, that for obtaining the maximum yield of adrenaline, the ideal procedure would be to chill the glands soon after collection from the slaughtered animals and to work them up within twenty-four hours. If the glands could be kept frozen, they could be transported even to distant places without seriously impairing their adrenaline contents. A cheaper, though less satisfactory method, which is practicable under the present-day conditions, would be to pack the glands (which have been sprinkled over with toluene) in ice and work them up in 2-3 days' time. Storage in alcohol also seems to hold out good prospects.

The expenses of this investigation have been met entirely from funds supplied by the Board of Scientific and Industrial Research, to whom our grateful thanks are due.

1. Dey, Krishnan, Srinivasan, *Curr. Sci.*, **1943, 12,** 151.

THE AMPHIBIAN SPERM

By B. R. SESHACHAR, D.Sc., F.Z.S.

(Department of Zoology, Central College, Bangalore)

THE Amphibia with its three existing orders, Urodela, Anura and Apoda, offers three different types of sperm structure. The Urodelan and Anuran sperms have been the subject of a number of memoirs which have dealt with their structure and development while the Apodan sperm has not been studied till now. Recently the author (1943*a*) has been able to work out in detail the sperm development in an Apodan example, *Ichthyophis glutinosus* and so it is possible for the first time to offer a comparative account of the sperms of the three groups of Amphibia.

The work of Meves (1897), MacGregor (1899), Broman (1900, 1901), Retzius (1906), King (1907), Terni (1911), Ballowitz (1913), Champy (1913, 1923), Morita (1928) and Gatenby (1931) has thrown considerable light on Urodelan and Anuran spermateleosis. This work has established one fact of importance, *i.e.*, that the sperms of these two groups are thoroughly unlike each other, and while anatomically these two great Amphibian orders are closely related, their spermatozoa fall under two entirely different categories.

The Anuran sperm is of uniform structure with a small acrosome surmounting an elongated nucleus behind which the two centrioles are lodged close together, and from the distal centriole the tail filament issues either as a simple flagellum (*Rana, Hyla, Pelobates*) or as one with an undulating membrane (*Alytes, Bufo, Bombina, Discoglossus*). The base of the flagellum is ensheathed by mitochondria which may or may not form a spiral investment and this mitochondrial sheath is often referred to as the 'middle piece' of the sperm (Fig. 1 *B*). In the case of *Hyla* (Retzius, 1906) there is a slight space separating the two centrioles and this space with its mitochondrial aggregation is called the 'middle piece'. The spermatozoon of *Bombinator* (Broman, 1900) is very peculiar in that the centrioles are situated, not behind the nucleus, but to a side of it anteriorly so that the flagellum runs parallel to the elongate nucleus during much of its course.

Compared with this simple sperm of Anura, that of the Urodela has a very complex structure. The acrosome and nucleus occupy the anterior end of the spermatozoon and are liable to considerable variation in size and shape. Closely following the nucleus is a conspicuous solid body of large size (Fig. 1 *A*). This is the proximal centriole which has become greatly enlarged and forms one of the constant features of the urodele sperm. Behind this trails the axial filament. The distal centriole undergoes a curious modification. It becomes converted into a ring which elongates greatly and lies on the side of the axial filament for most of its length. The mitochondria are generally absent from the adult urodele sperm.

As already observed, the Apodan sperm has not been studied at all and the only observation regarding it is that by the Sarasins (1890) who have provided a very meagre account of the sperm of *Ichthyophis glutinosus*. Its structure and development have been studied by me (1943*a*) recently and as a result, it is possible for the first time to compare it with the sperms of Urodela and Anura. In the Apodan sperm (Fig. 1 *C*) the acrosome and

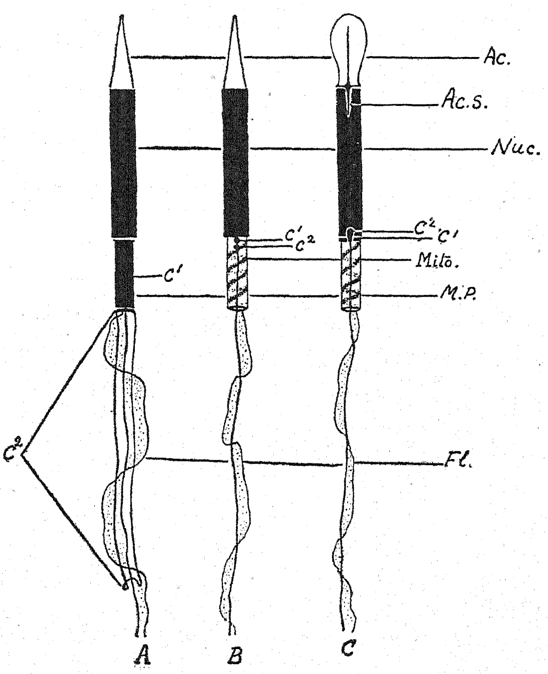

FIG. 1. Diagram showing the structure of the sperms of Amphibia. *A*. Urodele sperm; *B*. Anuran sperm; *C*. Apodan sperm.

Ac. Acrosome; *Ac. s.* Acrosome seat; C^1. Proximal centriole; C^2. Distal centriole; *Fl.* Flagellum; *Mito.* Mitochondria; *M.P.* Middle piece; *Nuc.* Nucleus.

nucleus are followed by a short 'middle piece' which is a spiral aggregation of mitochondria around the base of the flagellum. The two centrioles are in close and intimate relation with the nucleus, the proximal fused with it posteriorly as a flat disc with a single perforation. The distal centriole becomes an elongated granule, which, passing through the orifice of the disc-shaped proximal centriole, becomes embedded in the nucleus. The

flagellum of the axial filament is provided with an undulating membrane which extends over a great part of its length.

The Acrosome and Its Seat.—The acrosome in Amphibia varies greatly in size, form and appearance. In most Anura (*Rana, Hyla, Bufo, Alytes*) it is a pointed lance-shaped body surmounting the nucleus. In *Pelobates* (Broman, 1901) it is of great length and twisted in a more or less cork-screw fashion. In *Discoglossus* (Champy, 1923) also it is extremely long and filiform and makes up half the length of the sperm. In urodeles, it is more variable. The acrosome of *Pleurodeles* and *Triton* resembles that of the Anura in being a lance-shaped pointed structure but in *Molge* it is bent in the form of a fish-hook (Ballowitz, 1913). All variations between these two forms may occur. The acrosome of the Apodan sperm is a bulb-shaped structure with a narrow stalk planted on the nucleus. In the five species of Apoda examined by me (*Ichthyophis glutinosus, Uræotyphlus narayani, Dermophis gregorii, Siphonops annulatus* and *Gegenophis carnosus*) the acrosome has this shape. The pointed acrosome in many animals has led to the belief that it helps in the penetration of the egg membranes during fertilisation and hence has been called the perforatorium. More recently with the discovery in a number of animal sperms of an acrosome which is of such a shape that an act of perforation is difficult if not impossible, this view has been given up in favour of the one whereby, the egg itself, by means of the changes taking place in its outer constitution, becomes capable of engulfing the sperm, so that penetration of the sperm into the egg is an act largely of the egg rather than of the sperm (Wilson, 1928). The Apodan sperm is a case in point, as here the sperm with its blunt and rounded acrosome could not perforate the egg membranes.

The acrosome and the nucleus being quite separate bodies, the union between the two is by means of a mechanism whose real nature has been obscure for a long time. Gatenby (1931) was probably the first worker to draw attention to this fact and in his work on the development of the spermatozoon in Urodela has correlated the presence of certain deeply staining granules with the formation of an acrosome seat in relation with the nucleus into which the acrosome is fitted. Earlier, similar granules had been noticed by Meves (1897), MacGregor (1899), Terni (1911) and Bowen (1922) in other Urodela, without however, their real significance having been understood. Recently I have described the acrosome seat in the Apodan form *Ichthyophis*. The acrosome gives off a lance-shaped plug which fits into a pit in the centre of the nucleus so that the two are held together firmly (Fig. 1 *C*, *Ac. s.*). No other account of the acrosome seat exists in regard to the Amphibian sperm but it is more than likely that future work will show that in all animals the acrosome and the nucleus are incorporated with each other by means of an apparatus which, while varying in the details of its constitution, is uniform in that its main function is to cement the acrosome and the nucleus.

The Nucleus.—The nucleus which, with the acrosome, constitutes the head of the spermatozoon, is also variable in form in the Amphibia but generally within not very wide limits. In the Urodela and Anura its form and shape are generally uniform. It is a deeply staining body, either cylindrical or pointed towards the anterior end (*Rana, Bufo, Triton, Alytes*). In *Bombinator* it is elongated, and broad anteriorly and pointed posteriorly. In the Apoda too there is a great uniformity in the matter of shape and form of the sperm nucleus. In the five species the author has been able to examine (1943) it is an elongated cylinder. In the matter of the size of the nucleus, however, there is no uniformity. I have recently attempted a line of study with a view to determine the volume relationships of the sperm nucleus and the nucleus of the spermatid. It is a matter of common knowledge that one of the most important changes involving the nucleus in spermateleosis is its condensation and consolidation and it is believed that in its transformation from the spermatid to the spermatozoon, the nucleus undergoes a progressive reduction in volume, presumably due to loss of fluid from the nucleus. The nucleus of the adult sperm, therefore, is a packed mass of chromatin in which no details of structure can be made out. The question naturally arises as to what the relationship is between the volume of the nucleus of the spermatid and that of the adult spermatozoon. No work on these lines has been done in any group of animals and it has been shown for the first time that so far as the Apoda are concerned, the condensation is very considerable, the volume reduction between the spermatid nucleus and sperm nucleus varying between 80 per cent. and 95 per cent. in the different species (Seshachar, 1943).

Centrioles.—The disposition of the centrioles in the Amphibian sperm varies very much and in this respect, the Anura and Apoda resemble each other while the Urodela stand apart. In the Anura, the centrioles lie one behind the other posterior to the nucleus (Fig. 1 *B*, C^1, C^2) in the form of granules (except in *Bombinator* where they lie alongside the nucleus and not behind). They are generally distinct from the nucleus and close to each other. In *Hyla* a short distance separates the two centrioles. From the distal centriole arises the flagellum. In the Apoda too, the centrioles lie behind the nucleus but in this group they are far more deeply and intimately associated with the nucleus (Fig. 1 *C*, C^1, C^2). The proximal centriole becomes a flattened disc-shaped structure adhering firmly to the nucleus behind and so intimately fused with it in the adult sperm as not to be distinguishable from it except by the use of special reagents. The centre of the disc has an orifice through which the distal centriole, becoming a spindle-shaped granule centres into the nucleus and lies embedded in it. In the adult Apodan sperm, therefore, it is not possible to distinguish the centrioles, as it is in the Anuran sperm, where the centrioles are clear and separate from the nucleus.

But the condition in the Urodela is very striking. The proximal centriole becomes

greatly enlarged as a deeply staining block adhering to the nucleus behind it, while the distal centriole becomes a ring and is drawn out along the flagellum as a long pessary-shaped structure extending over a considerable length of the tail filament. No granular centrioles are found in the adult spermatozoon of any Urodele.

The 'Middle piece'.—The term 'middle piece' is used to designate any region, however different in structure, provided it is immediately posterior to the nucleus. This is more clear in Amphibia than in any other group, for the 'middle piece' is different in the three orders of Amphibia. In the Anura, the centrioles are, as has been observed, behind the nucleus and the mitochondria invest the base of the axial filament as a sheath. The mitochondrial sheath with the two centrioles is called the 'middle piece'. In *Hyla* (Retzius, 1906), the centrioles are separated by a short space and this space with the mitochondrial aggregation is called the 'middle piece'. In the Apoda, since both the centrioles are more closely associated with the nucleus than in the Anura, the 'middle piece' is purely a mitochondrial aggregation behind the nucleus. In the Urodela on the other hand, the conditions are quite different. There are generally no mitochondria in the adult urodele sperm and the term 'middle piece' is, therefore, applied to the conspicuously large proximal centriole which is just behind the nucleus (Fig. 1 *A*). So, while the term 'middle piece' is applied to the mitochondrial aggregation in the Anuran and Apodan sperms, it is the proximal centriole itself that is termed 'middle piece' in the urodele sperm.

The mitochondria in the 'middle piece' of the Apodan sperm (presumably also in the Anuran) occur inside a cylindrical transparent tube fitted to the posterior end of the nucleus. The origin of this tubular sheath I have been able to trace in *Ichthyophis* (1943 *a*). Around the posterior end, and at the sides of the transforming spermatid nucleus there appears a space which is gradually pushed backwards and becomes the tubular sheath in which mitochondria aggregate and arrange themselves in a spiral fashion around the axial filament. The presence of three different structures in the 'middle piece' of the Apodan sperm has to be recognised: (1) The axial filament which arises in relation with one of the centrioles, (2) the mitochondrial aggregation which is a spiral investment around the base of the axial filament, and (3) the transparent tubular sheath which holds the mitochondria in place. While the earlier workers had described the first two of these, the presence of the third has not been explained so far.

From the foregoing account of the spermatozoa of the three groups of Amphibia, it is clear that they fall under three entirely different categories. Of these, the Anuran sperm is the simplest. The Apodan sperm resembles it greatly, especially in the close association of the two centrioles with the nucleus as well as in the mitochondrial 'middle piece'. The Urodelan sperm on the other hand, in the great enlargement of the proximal centriole to form a solid body and the curious elongation of the distal centriole to form an accessory structure running along the tail filament, provides a condition unique in the animal kingdom.

I wish to thank Prof. A. Subba Rau for his kindness and encouragement and for his many useful suggestions.

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OBITUARY

SIR EDWIN BUTLER, C.M.G., C.I.E., F.R.S.

As it must to all living beings, death came to Sir Edwin Butler on April 4, 1943, following an attack of influenza. That he was ill was known for some time but no one had realised that his end was so near.

Edwin John Butler was born on August 13, 1874, in Co. Clare, Ireland and received his early education at the Queen's College, Cork. He took the Bachelor's degree in medicine from the Royal University, Ireland, in 1898, but having come under the influence of Professor M. M. Hartog at the Queen's College, he preferred the study of fungi to the practice of medicine. That aquatic Phycomycetes should attract him in Hartog's laboratory is natural and obtaining a travelling fellowship in 1899, he spent two years on the continent where the study of fungi had made great strides. He studied under Cornu and van Tieghem at Paris and Poirault at Antibes and spent some time at Freiburg where a few decades previously de Bary studied and taught mycology and attracted students from all over Europe.

In 1901 Butler was appointed Cryptogamic Botanist to the Government of India with headquarters at the Royal Botanic Gardens, Calcutta. In India fungi had been collected by Koenig, a student of Linnaeus and the first

Indian fungus was named by Linnaeus himself, *Lycoperdon pistillare* [= *Podaxon pistillaris* (L.) Fr.]. Other collections had also been made and named but a study of fungi did not begin in India until after D. D. Cunningham's arrival in 1869.

Cunningham, an Indian Army Medical Officer, came to India to discover the cause of Cholera and other tropical diseases and later became Professor of Physiology at the Calcutta Medical College. He had received training in mycology under Berkeley, Hallier and de Bary and his interest in fungi was thus natural. It was his practice, therefore, to deal with all enquiries regarding fungi received at the Royal Botanic Gardens at Calcutta from all parts of

India. At about the same time, between 1885-1892 to be precise, A. Barclay was conducting at Simla very critical experiments on the life-histories of rusts. The work done by Cunningham and Barclay must have been so effective that Government evidently realised the need for the services of a whole-time Cryptogamic Botanist which led to Butler's appointment. In 1902 Butler was transferred to Dehra Dun and in 1905 to the newly started Agricultural Research Institute at Pusa with the designation of Imperial Mycologist.

In India the years 1901 to 1921 must have been of great activity. Fungi, both those occurring on wild and crop plants had to be collected, studied and identified; a mycological laboratory had to be established, a herbarium started and contacts made with mycologists abroad for obtaining literature and specimens. Pressing problems in plant diseases needed immediate attention and countless enquiries had also to be attended to but above all students had to be trained to man the different provincial agricultural departments.

To these tasks Butler set himself with zest and vigour. The work started in Europe on aquatic Phycomycetes was completed, four species of *Pythium*, five of *Pleolpidium* and two of *Nowakoskiella* being established. The classical studies on the diseases of palms and sugarcane, on wilt of pigeon peas, on wheat rusts, on the downy mildews, etc., were commenced and carried out with thoroughness and the papers written on them will ever remain models of clear thinking, lucidity and scholarship. Collections made in different parts of India were all carefully studied and named, resulting in five papers on Indian fungi in collaboration with Sydow. One genus of rusts, *Cystopsora* and another of water moulds, *Allomyces*, were established, the latter of which has yielded the most interesting life-history among the Oomycetes. Nearly one hundred and fifty species stand to Butler's credit, some of them with Sydow.

In 1910 Butler started collecting material for a book on Indian plant diseases, *Fungi and Disease in Plants*, published in 1918, being the result. This book which is now unobtainable, will, in spite of any number of new books, ever remain the reference text in India. In 1931 he published, with G. R. Bisby, the *Fungi of India*.

Butler finally left India in 1921 to take up the Directorship of the newly established Imperial Bureau of Mycology, now Imperial Mycological Institute, at Kew. Here he became a figure not only of Empire but of international repute. He founded the *Review of Applied Mycology*, a journal indispensable in all institutions where mycological problems, be they agricultural, medical or industrial, have to be dealt with. In 1926 he was elected to the fellowship of the Royal Society and to its Council in 1934. He was the Chairman of the mycological section of the International Congress of Plant Science held at Ithaca in 1926 and gave, in 1939, the Lowell lectures at Harvard, from where had lectured such eminent men as Farlow, Thaxter and Blakeslee.

Indian mycologists will always speak of him in terms of gratitude for the fillip he gave to the study of fungi, for founding a fine herbarium and for the exhaustive research he did on the plant diseases of India. His knowledge of Mycology and Pathology was encyclopædic and in him the two sciences represented a happy mean.

He was made a C.I.E. in 1912 and C.M.G. in 1931 and was Knighted in 1939. He leaves behind Lady Butler, one son and two daughters.

B. B. MUNDKUR.

LETTERS TO THE EDITOR

TWO MORE PLANETARY SYSTEMS

OBSERVATION has at last come to the aid of theory which had given conflicting verdicts on the uniqueness of the Solar System. A planetary companion to the 61 Cygni system has recently been discovered by Dr. K. Aa. Strand (Feb. 1943) from a study of parallax observations of the star. A periodic deviation from the Keplerian orbit was found for the system, and this can only be due to the presence of a third body (61 Cygni C) of small mass. 61 Cygni C is found to be sixteen times as massive as Jupiter and very feebly luminous. It can, therefore, be classified as a planet.

Reuyl and Holmberg (Jan. 1943) have about the same time discovered a non-solar planetary body of even smaller mass in the binary star system, 70 Ophiuchi. As both the stars, 61 Cygni C and 70 Ophiuchi, are within 10 parsecs of the Sun (Jeans, 1929*a*), it is significant that two other planetary systems have been discovered quite close to our Solar System.

These observations very much weaken the case for the tidal theories of Jeans (1919) and Jeffreys (1929), according to which planetary systems should be very rare. Jeans (1929) estimates that on his theory about one planetary system in the whole of the galactic system should be formed every 5,000 million years. This gives us at the most two planetary systems in our galactic system, if we take the age of the Universe to be between 10^9 and 10^{10} years. Planetary systems have hardly any chance of being formed on Lyttleton's binary star collision theory (1938).

Banerji's Cepheid theory (1942), on which a star passes an oscillating Cepheid at a moderate distance and disrupts it, makes the birth of planetary systems much more probable. We shall quote Banerji on this point (1942*a*), "One conclusion seems to be irresistible. If the theory be correct in its essentials, there may be more planetary systems than at present supposed". Banerji's conclusion is fully borne out by the recent observations.

It may be remarked that the author has recently advanced a Cepheid theory of the origin of binary stars (Sen, 1941-42), which makes it possible for binary stars to possess planetary systems. Radiation of energy and consequent increase of angular velocity causes a Cepheid to break up into a double star system. The filamentary ribbon connecting the two stars may condense into planets.

Department of Mathematics,
Allahabad University,
August 7, 1943. H. K. SEN.

1. Banerji, A. C., *Proc. Nat. Inst. Sci. Ind.*, 1942, **8**, 173-97. 2. —, *loc. cit.*, 1942*a*, p. 196. 3. Jeans, J. H., "The Problems of Cosmogony and Stellar Dynamics," 1919, p. 275. —, "Astronomy and Cosmogony," 1929, p. 409. 4. —, *loc. cit.*, 1929*a*, pp. 7 and 22. 5. Jeffreys, H., "The Earth," 1929, p. 16. 6. Lyttleton, R. A., *M.N.*, 1938, **98**, 536. 7. Reuyl and Holmberg, *Ap. J.*, Jany, 1943, **97**, 41. 8. Strand, K. Aa. *Publ. Astron. Soc. Pac.*, Feb. 1943, **55**, 29. 9. Sen, H. K., *Science and Culture*, 1941-42, **7**, 582.

EFFECT ON B.H. CURVES OF ELECTRIC CURRENTS THROUGH A TRANSFORMER CORE

THE B.H. curves for ferromagnetic materials as obtained on a cathode-ray oscillograph provides a good visual and photographic method for studying the variations in the magnetic properties of these materials with various physical changes. The hysteresis loop can be obtained on the oscillograph provided only with electrostatic deflection plates (Fig. 1) if a resistance (R_1) is included in series with the primary coil of the transformer, and a suitable phasing condenser (c) and resistance (R_2) are present in the secondary circuit. The magnetising force is proportional to the primary current and thus to the voltage built in the series resistance (R_1) and this is applied after amplification for horizontal deflection of the beam, while the voltage in R_2 is proportional to B and is applied after amplification to the plates giving vertical deflection.

With this circuit we have tried to study any change in the loop if simultaneously with the current through the primary or secondary coils, we send an electric current through the iron core of the transformer (shown by arrows).

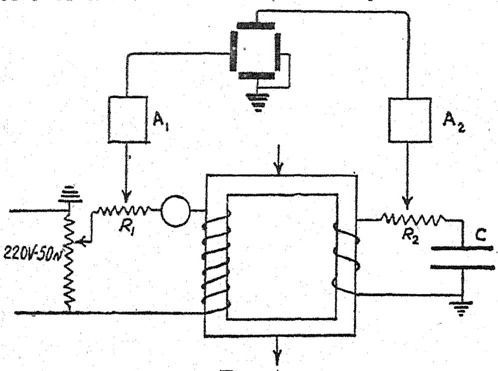


FIG. 1

A_1, A_2 Amplifiers

Some change would not be unexpected on general theoretical considerations as in each cycle of current passing through the primary, there is a reversal of the magnetic field through the core and the spin axis of the magnesting electrons would reverse in direction each time. Now if, in addition to this magnetic field acting on the core, an electric current was to traverse it, the flow of these myriads of electrons may interfere with the free reversal cf the spin axes and produce a widening of the hysteresis loop.

A photographic exposure of the hysteresis pattern was obtained on the camera plate, first

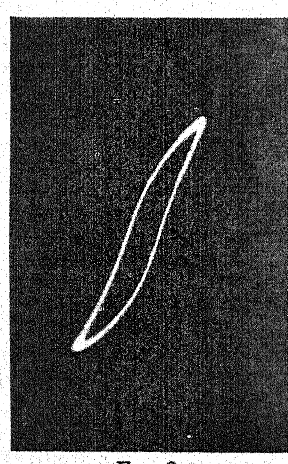


FIG. 2

in the normal condition, *i.e.*, without current in the core and then without disturbing the position of the camera or any other part of the apparatus, the current through the core was switched on, and a further exposure given on the same plate.

With D.C. current upto 5 amps., the two patterns are completely superposed showing no trace of change. Same result is obtained, with the direction of the current reversed (Fig. 2). With an A.C. current (3 amps.), and same frequency (50 cyc.) as that flowing through the coils, a broadening of the loop takes place (Fig. 3), with the peculiarity that the widening is marked only during the two quarter

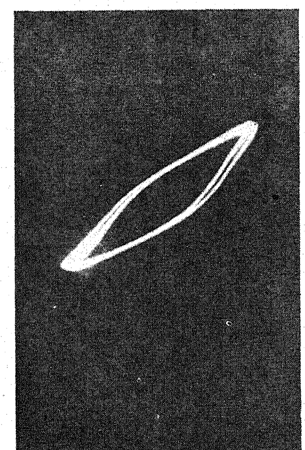


FIG. 3

cycles when the magnetising current is increasing on the positive side or on the negative side. During the quarter cycles when the magnetising current is decreasing the two traces are superposed. With the A.C. currents induced effects in the coils have to be taken into consideration. But the change depicted is quite peculiar and although induced effects will be there, the atomic magnetic properties may also have to be considered.

However, we are carrying on these experiments along with other variations as to temperature, etc., which will throw more light on this phenomenon. We owe our gratitude to Prof. J. B. Seth for facilities provided for this work.

Physics Laboratories,
Government College,
Lahore,
July 27, 1943.

H. R. SARNA.
P. N. KALIA.
JAI DYAL DHINGRA.

1 K. Kreiselheimer, *J. Sci. Inst.*, 1942, **19**, 137. 2. Reyner, *Cathode Ray Oscillograph*.

SPECIFIC HEAT OF SOLID CARBON DIOXIDE

IN a symposium of papers[1] which appeared in the *Proceedings of the Indian Academy of Sciences*, the Raman theory[2] of specific heat has been applied to many elements and simple ionic compounds, namely, rocksalt and sylvine. The thermal energy of rocksalt calculated on the basis of the discrete, though weak, Raman lines reported by Fermi and Rasetti[3] for a single crystal has been shown by the author[4] to be in good agreement with the experimental data. In the present note, the investigation has been extended to molecular compounds.

Sirkar and Gupta[5] have observed an intense and sharp Raman line at 58 cm.$^{-1}$ for solid carbon dioxide, besides the inner frequencies of the molecule. The latter, however, attributed

this line to inter-molecular oscillations of polymerised groups of molecules in the solid. In a note[6] to *Current Science*, I have shown that this frequency-shift agrees approximately with the Lindemann frequency as well as with the Pauling rotational frequency of solid CO_2. I was thus led to conclude that the new line observed by Sirkar arises from coherent rotational oscillations of molecules in the crystal lattice. This point of view has been fully supported by later theoretical and experimental researches on the subject by several authors.

In the present note, the following frequencies, duly corrected for low temperatures, are adopted for the calculation of specific heat of carbon dioxide: 668, 1,336 and 2,350 cm.$^{-1}$ for internal frequencies and 63 cm.$^{-1}$ for rotational frequency and 122, 61·5 and 32 cm.$^{-1}$ for the first, second and third order lattice translational frequencies. The specific heat, C_v at any temperature T° K. is represented by the relation,

$$C_v = 1/3\mathrm{E}\left(\frac{958}{\mathrm{T}}\right) + 1/3\mathrm{E}\left(\frac{1915}{\mathrm{T}}\right) + 2/3\mathrm{E}\left(\frac{3370}{\mathrm{T}}\right) + 8/3\cdot 1/3\mathrm{E}\left(\frac{93}{\mathrm{T}}\right) + 3/4\cdot\mathrm{E}\left(\frac{180}{\mathrm{T}}\right) + \frac{7}{4\times 8}\mathrm{E}\left(\frac{90}{\mathrm{T}}\right) + \frac{7}{4\cdot 8\cdot 8}\mathrm{E}\left(\frac{45}{\mathrm{T}}\right).$$

TABLE I

T°K	C_v Raman Theory	C_p Observ.	C_v Observ.	C_p B & Z
15	**0·52**	·54	**·54**	·52
20	**1·286**	1·23	**1·23**	1·16
30	**3·067**	3·08	**3·08**	2·95
40	**4·624**	4·69	**4·65**	4·70
50	**5·824**	6·10	**5·88**	6·11
60	**6·715**	7·18	**6·82**	7·17
70	**7·437**	7·97	**7·48**	7·98
80	**7·866**	8·58	**7·77**	8·61
90	**8·237**	9·11	**8·29**	9·12
100	**8·541**	9·53	**8·53**	9·54

The experimental value of C_v is computed from the data for C_p and the melting point of CO_2. The values of temperature, C_v (calculated), C_p (observed) and C_v (observed) are given in columns 1 to 4 of Table I. Column 5 gives the values of C_p calculated by Brucksch and Ziegler[7] on the basis of the theoretical views of Andrews and Lord for comparison. The excellent agreement between the experimental values of specific heat and those calculated according to Raman's theory shows that the latter is applicable to molecular compounds as well.

University College,
Trivandrum, C. S. VENKATESWARAN.
September 6, 1943.

1. Symposium of papers on thermal energy of crystalline solids, *Proc. Ind. Acad. Sci.*, (A), 1941, **14**, 459-506. 2. Raman, C. V., *Ibid.*, 1941, **14**, 459. 3. Fermi and Rasetti, *Zeit. f. Physik*, 1931, **71**, 689. 4. Venkateswaran, C. S., *Proc. Ind. Acad. Sci.*, A, 1941 **14**, 506. 5. Sirkar and Gupta, *Curr. Sci.*, 1937, **6**, 21. 6. Venkateswarn, C. S., *Ibid.*, 1938, **6**, 378. 7. Brucksch and Ziegler, see *Joun. Chem. Physic*, 1942.

ABSORPTION SPECTRA OF ORTHO-DICHLOROBENZENE

A CAREFUL study of the ultra-violet absorption spectra of *o-dichlorobenzene* has been made using a very simple method of developing the absorption bands. A hydrogen discharge tube was used as the ultra-violet source and the vapour was contained in a tube 20 cm. long and 2·5 cm. in diameter with plane quartz windows at both ends. Twelve absorption bands have been obtained at the optimum condition corresponding to 14 mm. mercury pressure and a temperature of 24° C.

The following are the wavelengths and wave-numbers of the band heads:—

No. of bands	λ in A° (in air)	ν per cm.$^{-1}$ (in vacuum)
1	2,799·1	35,716·5
2	2,794·2	35,779·1
3	2,774·1	36,038·4
4	2,767·3	36,126·9
5	2,762·6	36,187·1
6	2,757·5	36,254·0
7	2,754·6	36,293·5
8	2,713·3	36,844·5
9	2,708·2	36,913·9
10	2,684·9	37,234·2
11	2,680·0	37,302·3
12	2,596·1	38,507·8

Muslim University,
Aligarh, KHALILULLAH SIDDIQI.
January 10, 1943.

AN ORTHOPYROXENE FROM DODKANYA, MYSORE

AN orthopyroxene occurs in large grains, sometimes 1 cm. in length, in a norite of the gneissic complex of Dodkanya bordering the Ultrabasic intrusives of the area. Mr. B. Rama Rao, Director of Geology, Mysore Geological Department, has had this mineral analysed in connection with his memoir on "Charnockites", which he is now writing. The analysis is herein reproduced with his kind permission.

The orthopyroxene is striated on the (100) and pyramidal faces, and, under crossed nicols, shows, occasionally, minute lamellæ, crossing the prismatic cleavages on pyramidal faces. The lamellæ are localised in certain areas of the same plate. The mineral plates show strain shadows. When tilted on the Universal Stage, the lamellæ on the pyramidal faces disappear towards (010) and (001) faces, but become sharp on the (100) face with alternating dark and bright bands. They give an extinction angle of ± 6° on pyramidal faces, which are cut near (010 — 100) zone, and ± 3° on the same faces, when tilted to the (100) position. The very minute lamellæ are, therefore, slightly variable in chemical composition. The mineral contains plenty of inclusions of plagioclase, which develop radial pressure cracks in the orthopyroxene host; and

a brownish-green amphibole, typical of the charnockites, develops at the contact of the guest with the host.

The crystal is set in Fig. 1, following the Pseudo-tetragonal rule applicable to crystal-setting in the Orthorhombic system, whereby angle $am < bm$.

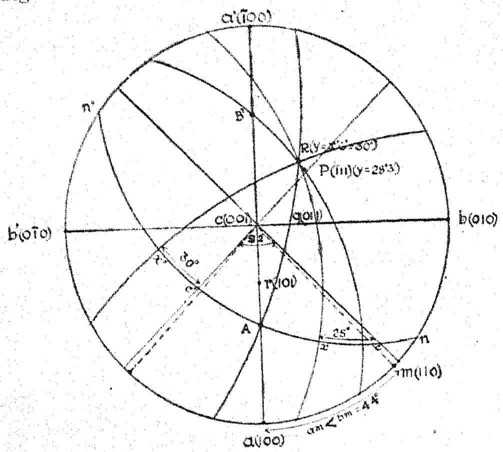


FIG. 1

The obtuse cleavage angle is 92°, and the optic plane bisects this angle; therefore XZ is // to (010). The optic axial angle was measured directly on the Federov's stage, on a (100) section of a grain not showing the lamellæ, by the method of sharp extinction in the 45° position. The optic axial angle is 73° 58′. The mineral is negative in optic sign and positive in elongation. $X = a$, $Y = b$ and $Z = c$; $Bx_{ac} = X$ and is $\perp r$ to (100). The mineral is intensely pleochroic with X = clear red, Y = pale yellow, and Z = clear green. The refractive indices are $\alpha = 1{\cdot}684$, $\beta = 1{\cdot}690$ and $\gamma = 1{\cdot}694$. $\gamma - \alpha = {\cdot}010$. The optical characters of this mineral are between those recorded for hypersthenes, from Lauterbach and Labrador.[1]

	Lauterbach	Orthopyroxene Dodkanya	Labrador
% FeO + MnO	10·6	10·5	14·8
2V over Z	95° (2V over X = 5°)	104°2′ (2V over X = 73°58′)	—
Ng	—	1·694	1·705
Nm	1·685	1·690	1·702
Np	—	1·684	1·692
Ng − Np	—	0·010	0·013

(100) and (010) sections give straight extinction, but others give oblique extinction with a maximum extinction angle of 31°. The section giving an extinction angle of 31° does not show any lamellæ. To test if this section was not cut parallel to a pyramid of the orthopyroxene, the grain was mounted on the universal stage, and the emergence of optic axis B′ was located giving the co-ordinates $a'_{E-W} = 20°\ 50'$ and $a'_{N-S} = 29°$ for the pole R. The pole R of the hypothetical pyramid and its trace are projected in Fig. 1. By the Biot-Fresnel Law, the cleavage angles on this hypothetical pyramid are the arcs x', c' and xc, which read 30° and 25° respectively. The extinction angle of 30°, thus deduced by the graphical method, is in close agreement with the observed angle 31°. For comparison is reproduced the calculated angle 28° 3′ for the unit pyramid P ($\bar{1}11$) of the hypersthene of Halagur.[2] The high extinction angles of the orthopyroxene under study, are therefore, the extinction angles, theoretically possible on pyramids of orthorhombic crystals.[3]

The chemical composition of the mineral is herein set down, alongside the chemical composition of orthopyroxenes of the Bushveldt type, studied by H. H. Hess and A. H. Phillips.[4] Analysis of a hypersthene from the Charnockites of Uganda is also included.

	I	III	IV	Orthopyroxene Dodkanya	Hypersthene Uganda	Metasilicate molecules: Orthopyroxene Dodkanya
SiO_2 ..	53·61	53·60	54·63	52·66	55·15	$MgSiO_3$ — 66·40
Al_2O_3 .	1·67	3·51	2·39	1·28	6·50	
Fe_2O_3 ..	1·48	0·79	1·71	5·47	2·10	$FeSiO_3$ — 17·29
FeO ..	6·70	11·38	7·07	9·36	17·68	
MgO ..	33·15	25·34	30·30	26·58	16·62	$CaSiO_3$ — 6·84
CaO .	2·32	4·19	2·20	3·30	1·58	
Na_2O ..	0·04	0·25	0·45	0·84	—	Na_2SiO_3 — 1·59
K_2O .	0·06	0·03	0·11	0·18	—	
H_2O .	0·54	0·27	0·52	0·19	—	$MnSiO_3$ — 1·70
H_2O ..	0·08	0·04	—	0·32	—	
TiO_2 ..	0·09	0·29	0·36	tr	0·03	$AlAlO_3$ — 1·28
P_2O_5 ..	tr	—	0·12	nil	—	
Cr_2O_3 ..	0·38	—	—	—	—	$FeFeO_3$ — 5·47
MnO ..	0·16	0·19	0·14	0·89	0·34	
	100·16	99·88	100·00	100·73	100·00	100·57

I, III, IV copied from the *American Mineralogist*, 1938, **23**, 453, H. H. Hess and A. H. Phillips.

Orthopyroxene, Dodkanya.—Analyst, B. Sadasiva Raju, Chemist, Mysore Geological Department.

Hypersthene, Uganda.—A. W. Groves, *Q.J.G.S.*, 1935, **71**, 156.

The chemical analysis of the Dodkanya orthopyroxene does not accord with that of the Charnockite type, but is in fair agreement with the analysis of the Bushveldt type, except for the high content of ferric iron, which accounts for the intense pleochroism of the Mysore mineral. The presence of alumina and alkalis in the analyses of orthopyroxenes is pointed out by Hess and Phillips to be characteristic of orthopyroxenes of the Bushveldt type. It may be remarked that the ratio of soda to potash, and of both to lime, are ratios, fairly constant in the rock analyses of the Charnockites of India. Hess and Phillips ascribe the CaO content to the presence of the Diopsidic molecule as lamellar intergrowths in the orthopyroxene host; they also hold that some of the low extinction angles are due to this intergrowth.

Calculating the chemical analysis in terms of metasilicate molecules, and expressing the mineral in terms of its minals, the mineral of Dodkanya has the formula,

$$En_{60}Hy_{17}Di_7\triangle_{16}.$$

Winchell[5] has proposed the restriction of the term Bronzite to an FeO tenor of 5-14 per cent. or of $FeSiO_3$ tenor of 9·2-25·72 per cent. The mineral under study is, therefore, a Bronzite of the Enstenite series, but it has not the typical inclusions of Bronzite.

University of Mysore,
Bangalore,
August 14, 1943.
P. R. J. NAIDU.

1. Winchell, A. N., *Elements of Optical Mineralogy*, 1933, **2**, 217. 2. Naidu, P. R. J., *Curr. Sci.*, 1943, **12**, No. 5, 158. 3. Johannsen, A., *Petrography*, 1937, **3**, 213. 4 *American Mineralogist*, 1938, **23**, 453. 5. Alling, H. L., *Interpretative Petrology of the Igneous Rocks*, 1936, p. 85.

A NOTE ON THE COAGULATION STUDIES OF THE LATEX OF *CRYPTOSTEGIA GRANDIFLORA* R. Br. AS A WAR-TIME SOURCE OF VEGETABLE RUBBER

In a previous communication[1] describing the Chemical and Technological investigations on *Cryptostegia grandiflora*, a method of coagulating cryptostegia latex with water was reported. This method consists in mixing 20 volumes of distilled water, 15-16 volumes of tap water or 6-8 volumes of hot water, to latex whereby it gets coagulated yielding a white coagulum of rubber which can be sheeted and a clear straw coloured or red serum.

When the pH value shifts towards the alkalinity side, coagulation takes place. Continuation of the investigations showed that although this method has the advantage that it does not require acids or other chemicals, it has the disadvantage that on the large scale it involves the use of large quantities of water and bigger coagulating tanks. It was, therefore, considered necessary to devise a still simpler and more advantageous method of coagulation. Investigations were carried out with a large number of substances such as calcium and sodium chlorides, sodium, potassium, calcium and ammonium hydroxides and carbonates, alcohol, acetic acid and formaldehyde and eventually the following method has been found to answer the purpose in view. The following tentative conclusions can be drawn:—

1. Latex can be coagulated by diluting it with water (1/100 part that of latex) of an alkalinity which would bring the final pH value to the vicinity of 7·7.
2. The per cent. dry rubber obtained does not vary much with coagulants.
3. Three volumes of a solution of lime water saturated at 31° C. (approximately N/25·5) are required to bring about coagulation, while of N/10 NaOH, N-NaOH, 10 N-NaOH, only 1, 1/10 and 1/100 volumes respectively are required.
4. The quality of rubber in every case is satisfactory and the coagulum can be sheeted.

Description of the Method.—Take latex (20 c.c.) in a beaker, add 10 N-NaOH (0·2 c.c.). The solution turns dirty pink. On warming to 80-90° C. it separates into a clear blood red to brownish red serum and a white coagulum of rubber. The coagulum is sheeted and after washing it with water till it is free of alkalinity, it is dried at 90-95° C. in an air oven.

The details will appear elsewhere.

Imperial Agricultural
Research Institute,
New Delhi,
August 17, 1943.
B. VISWA NATH.
R. H. SIDDIQUI.
S. A. WARISI.
V. V. K. SASTRY.

1 *Journal, Board of Scientific and Industrial Research*, July 1943, **1**, No. 4, 365-57.

THE BERBERINE CONTENT OF *COSCINIUM FENESTRATUM* (COLEBR.)

We are glad to confirm the observation of Varier and Pillai[1] that berberine is the predominant alkaloidal constituent of *Coscinium fenestratum* by putting on record a brief note of an examination of Ceylon material carried out in 1939.

Air-dried stems (moisture 6·8 per cent., ash 2·6 per cent.) were exhausted with 95 per cent. alcohol in a Soxhlet apparatus, which removed 9·2 per cent. of material. From the alcoholic extract berberine is readily precipitated as the acid sulphate by addition of a slight excess of sulphuric acid (the yield of crude salt 4·1 per cent.).

The combined filtrates after separating and washing the berberine acid sulphate with alcohol, were evaporated and taken up in water and ether; the latter solvent removed resinous matter (4·1 per cent.). The aqueous solution after thorough ether extraction was made alkaline with caustic soda and again extracted with ether which removed 0·67 per cent. of crude alkaloids. After treatment with carbon dioxide, the aqueous liquor yielded to ether a further 0·2 per cent. of crude phenolic alkaloids.

We should not, therefore, go as far as Varier and Pillai in stating that berberine is the only

alkaloid present and we consider that further investigation (for which we have not the opportunity) would be worth while.

Composition of Ash.—Insoluble in 2-N hydrochloric acid: 6·6, CaO 36·8, K_2O 7·6, Cl' 0·33 per cent. The high calcium content is noticeable, corresponding to 1·0 per cent. CaO on the original stems.

Coconut Research Scheme,
Lunuwila, Ceylon, R. CHILD.
September 1, 1943. W. R. N. NATHANAEL.

1. Varier N. S., and Pillai, P. P., *Curr. Sci.*, August 1943, **12**, No. 8, pp. 228–229.

THYROXINE-IODINE CONTENT OF THYROID GLAND POWDERS OF INDIAN MANUFACTURE

IN June 1942, Prof. B. B. Dey of the Madras Presidency College stated in a personal communication to the writer that "the thyroid glands of cattle collected in Madras have been found to contain a much higher iodine content than the continental specimens". This statement, not being in consonance with the widespread belief that Indian cattle are poor sources of glandular products, did not attract much attention of the writer and his co-workers at that time. Evidences have since been obtained which strongly support the statement of Prof. Dey and as this is likely to have a definite bearing on the manufacture of glandular products in India the publication of a 'note' is considered worth while.

Desiccated Thyroid gland powders prepared from local glands in a University Chemical Laboratory, in a Research Institute and in a commercial firm were carefully tested for their thyroxine-iodine contents by the method outlined in the B.P., 1932, and the First Addendum to the B.P., 1936, with the following results:—

Sample from:	*Thyroxine-iodine*
(1) Univ. Lab. (S. India)	0·33 per cent. (Average—3 determinations)
(2) Research Institute (S. India)	0·20 per cent. (Average—3 determinations)
(3) Commercial Firm (Bengal)	0·18 per cent. (Average—3 determinations)

B.P. limits—(0·09 to 0·11 per cent.)

Three samples of Thyroid powder obtained from Great Britain and Canada in 1939 and stored in the Refrigerator in sealed amber bottles were simultaneously tested for their thyroxine-iodine contents with the results given below:—

Sample from:	*Thyroxine-iodine*
(1) A. H. & Co., Ltd.	0·142 per cent. (Average—3 determinations)
(2) B. D. H. & Co.	0·235 per cent. (Average—3 determinations)
(3) Canadian Sample	0·120 per cent. (Average—2 determinations)

It will be seen that excepting in one instance (No. 2), thyroxine-iodine content of foreign thyroid gland powders are lower than the values obtained with powders prepared from glands of Indian cattle.

In addition to this, the author has carried out biological assays on several samples of thyroid bearing the name of Indian manufacturers but where no information was available with regard to the exact origin of the powders. Presumably some of these are of *Indian* make and in many such cases, a potency higher than B.P. (using a standard powder with known thyroxine-iodine content as control) was obtained by the 'tadpole method'.[1] Some of these samples were received in such small quantities that confirmatory chemical assay and determination of thyroxine-iodine contents were not possible.

While it is realised that the data available are not comprehensive, a tentative opinion may be expressed that, at least as far as the thyroid gland preparations are concerned, Indian manufacturers need not always feel that the raw material obtainable in India is of an inferior grade than that obtainable in Western countries where the nutrition of the cattle is definitely superior.

I am indebted to my colleagues in the Laboratory for carrying out most of the tests.

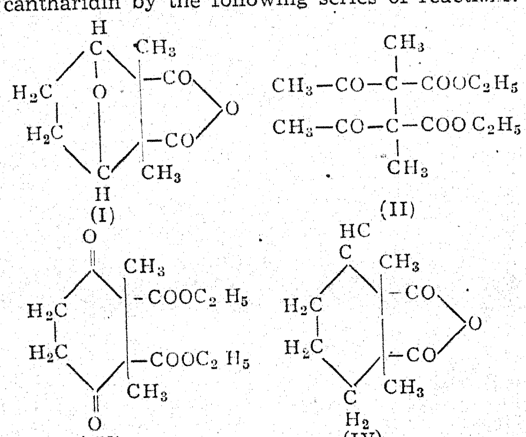
Bio-Chemical Standardisation
Laboratory, Calcutta,
August 11, 1943. B. MUKERJI.

1. Dutt and Mukerji, *Curr. Sci.*, 1942, **11**, 104.

SYNTHESIS OF CANTHARIDIN

CANTHARIDIN, the active principle of *Cantharis vesicatoria* and *Mylabris pustulata* Fb. India, has been assigned the structure (I) mainly on the basis of analytical evidence by Gadamer and collaborators.[1] Recently the synthesis of desoxycantharidin (IV) by Woodward and Loftfield[2] has confirmed the structure (I) for cantharidin.

Various unsuccessful attempts at the synthesis of cantharidin have been recorded.[3] We have now synthesised cantharidin and desoxycantharidin by the following series of reactions.



(I) (II) (III) (IV)

Sodio derivative of ethyl methyl acetoacetate when treated with iodine gave diethyl $\alpha\alpha'$ dimethyl $\alpha\alpha'$ diacetyl succinate (II). Bromination of (II) followed by debromination by

molecular silver gave diethyl 1-4-diketo-2-3-dimethyl cyclohexane-2-3-dicarboxylate (III). Clemmensen reduction of (III) followed by hydrolysis gave desoxycantharidin (IV). Reduction of (III) by aluminum isopropoxide followed by etherification and hydrolysis by sulphuric acid gave cantharidin (I), m.p. 217°. Mixed m.p. of the synthetical cantharidin with an authentic sample from *Mylabris pustulata*, kindly supplied by Dr. P. C. Guha (Indian Institute of Science, Bangalore) to whom our thanks are due, was also 217°. Further details will be published shortly.

Maharaja Pratapsinha Chemical Laboratories, Sir Parashurambhao College, Poona,
August 10, 1943.

(Miss) K. Paranjape.
N. L. Phalnikar.
B. V. Bhide.
K. S. Nargund.

1. Gadamer, *Arch. Pharm.*, 1914, **252**, 623, 636, 660.
2. Woodward and Loftfield, *J.A.C.S.*, 1941, **63**, 3967.
3. Coffey, *Rec. Trav. Chim.*, 1923, **42**, 1026; Steele, *J.A.C.S.*, 1931, **53**, 283; Iyer and Guha, *Jour. Ind. Inst. Sci.*, 1931, **14A**, 31; 1938, **21A**, 115; 1940, **23A**, 159; Pai and Guha, *Jour. Ind. Chem. Soc.*, 1934, **11**, 231.

CLAVICEPS PURPUREA (Fr.) Tul. AND A NEW SPECIES FROM SIMLA

Pushkar Nath and Padwick[1] recorded the presence of ergots on grasses at Simla, the hosts including *Brachypodium sylvaticum* Beauv. and *Oplismenus compositus* Beauv.

The fungus producing ergots on *Brachypodium sylvaticum* is *Claviceps purpurea* (Fr.) Tul.

A large number of *Brachypodium* ergots was found germinating in nature immediately below the plants at Simla on August 9th, 1942. These ergots measured 1·6 × 16 (1·4 – 2·0 × 7 – 35) mm. The stromata were purple or brownish yellow, slightly pitted or tuberculate, borne on a purple or brownish-yellow stipe, measuring up to 1·5 × 28 mm. The globose to subglobose capitula measured 2·8 (1·5-3·0) mm., and the ovate perithecia 147 × 259 (119-170 × 246-280) μ, asci 2·6 × 125 (2·4-3·6 × 81-173) μ and ascospores 98 (81-136) μ.

In 1942 successful attempts were made to inoculate rye and wheat with spores formed in potato dextrose agar cultures of the *Brachypodium* fungus. Ergots formed on rye, and eventually reached a maximum size of 2·5 × 13 mm., and were straight, furrowed, purplish-brown in colour, and hard at maturity. They were in every way typical of *Claviceps purpurea*. Those on wheat were smaller, measuring up to 4 × 10 mm.

In addition to the collection of germinating ergots of *Brachypodium sylvaticum*, a large number of germinating ergots from *Oplismenus compositus* was collected immediately beneath plants of that species on August 22nd, 1942. The ergots measured 1·3×6·4 (1·0-1·5×4-10) millimetres. The capitula were yellowish-green in colour, tuberculate, borne on a yellow stipe which measured up to 4·2 cm. in length. The diameters of the capitula varied from 1·0 to 1·6 mm. The perithecia measured 203 × 323 (170-229 × 280-357) μ; asci 2·6 × 178 (2·0-3·1 × 148-242) μ; and ascospores 145 (119-188) μ. Conidia found on ergots on the host plant were greenish coloured in mass, giving the sclerotia a greenish hue. Even singly they had a slightly green colour. They measured 3·8-8·4 (3·4-4·6 × 4·2-18·9) μ.

Pure cultures of the *Oplismenus* fungus were repeatedly obtained by surface sterilizing the sclerotia and plating on potato dextrose agar. Slow-growing cultures resulted, consisting of a much convoluted greenish-yellow mass, finally becoming darker green, and consisting largely of masses of spores which were somewhat smaller than those formed on the ergots, namely, 2·4 × 9·8 (1·6-3·8 × 3·3-12·6) μ.

On the basis of spore length, colour of stipe, and particularly the striking green colour exhibited by the fungus in all its stages, it differs from all known species of *Claviceps*, and is regarded as a distinct new species, to which is given the name *Claviceps viridis*.

Claviceps viridis, Padwick et Azmatullah, sp. nov.

Sclerotiis viridibus vel viride-nigris, cylindraceis, curvatis, 1·3 × 6·4 (1·0-1·5 × 4-10) mm. Stromatibus in quoque sclerotio quotcumque 4; stipitibus cylindraceis, flavis, ad 4·2 cm. longis, 0·5 vel 0·8 mm. diam.; capitulis globosis vel subglobosis, flavido-viridibus vel fuscis, tuberculosis, 1·0 vel 1·6 mm. diam. Peritheciis ovatis, ostiolatis papillaribus, 203 × 323 (170-229 × 280-351) μ; ascis cylindraceis, apicibus rotundatis, basibus attenuis, 2·6 × 178 (2·0-3·1 × 148-242) μ; ascosporidiis 145 (119-188) μ longis. Conidiis hyalinis vel palido viridibus globosis vel cylindraceis, strictis vel cuvatis, 3·8 × 8·4 (3·4-4·6 × 4·2-18·9) μ.

In terra, sub plantis *Oplismenorum compositorum* Beauv., leg. Md. Azmatullah, Simla, 25-8-42 (Typus). Statis conidicis et sclerotiicis in ovariis *Oplismenorum compositorum*, leg. Pushkar Nath, Simla, Nov. 1942.

Imperial Agricultural Research Institute, New Delhi,
August 9, 1943.

G. Watts-Padwick.
Md. Azmatullah.

1. *Curr. Sci.*, 1941, **10**, 488.

ON THE NEMATODE *INDIANA GRYLLOTALPAE*, GEN. et. SP. NOV. FROM *GRYLLOTALPA* SP.

Host: *Gryllotalpa* sp.
Location: Gut.
Locality: Calcutta.

Basir* has recently founded four new genera of nematode worms obtained from *Gryllotalpa* sp. in the Aligarh district. At the time of examination of the gut contents of the insect in this laboratory four Oxyurid worms were collected and placed at my disposal. All the specimens except one have unfortunately been mutilated at the time of collection.

The worms collected are all female and small in size. The entire specimen measures 1·7 mm. in length. The lips are inconspicuous, behind which there is a number of broad

cuticular longitudinal appendages directed backwards. The œsophagus ends in a rounded bulb with valvular apparatus. The caudal extremity

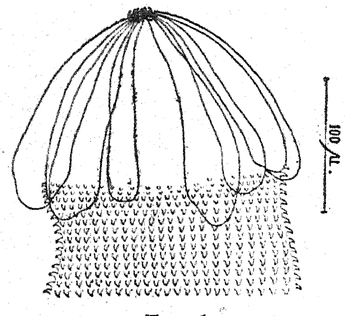


FIG. 1

Indiana gryllotalpæ. Female. Anterior extremity

terminates abruptly in a narrow spike. The cuticle, except on the caudal spike, is beset with distinct spines arranged in close-set transverse rows. The cuticle on the anterior end also appears to be devoid of spines. The spines are directed backwards and those on the posterior part of the body are larger than others. The eggs are oval and thick-shelled.

The worms under report, however, cannot be identified with any genus founded by Basir, nor with any other known nematode genus, a new genus and a species to accommodate it, appears necessary.

The detailed description of the worm will be published later.

Zoological Laboratory, G. K. CHAKRAVARTY.
University of Calcutta,
June 29, 1943.

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* Basir, M. A., *Recd. Ind. Mus.*, Calcutta, 1942, **44**, Pt. I, pp. 95–106.

EFFICIENCY OF SOME SAMPLING METHODS FOR WHEAT CROP

SAMPLING saves much time, labour and expense in getting information regarding yield, relative value of different varieties with different manures for crops spread over extensive areas. But the sampling problem is a difficult one, because the method differs from crop to crop, place to place and even from field to field. The sampling procedure depends mainly on the material to be sampled. If the material is homogeneous, the procedure is comparatively simple; but in case it is heterogeneous complicated methods will have to be devised for taking the samples.

It is known that the error variance of the estimated value on the basis of the unit of sampling is $\left(1-\frac{n}{N}\right)\frac{s^2}{n}$;[1] where N is the total number of units in which the whole area can be divided, n is the number of units actually sampled and s^2 is the variance between the units. Again the percentage loss of information due to sampling in any experiment is $(1-q)\ \frac{B}{A}\times 100^2$; where q is the proportion sampled from each plot, B is the variance between the sampling units within the plots, and A is the variance between the plots. The above formulæ show that the efficiency of a sampling method depends on (*i*) the proportion sampled, (*ii*) the variance between the sampling units. As the variance between the units depends on their size, the size also should be such as to have a low coefficient of variation for that particular size.

Many workers[3,4] have tried to arrive at the best method of sampling by the aid of the criterion mentioned above. Their conclusions are based mostly on the results of a few experiments from plots ranging from 1/17th to 1/5th of an acre. For rice, Hubback[5] has arrived at some general conclusions from data collected over extensive areas. But no attempt has been made to judge the efficiency of different methods of sampling by any intensive work. In this note we have dealt with the efficiency of a few sampling methods with reference to wheat on the basis of the Karnal wheat uniformity trial data, which has been published in full in a previous publication.[6]

The whole area 1·1478 acres consisting of two thousand 5′ × 5′ plots (25 rows × 80 columns) was divided into four equal parts or blocks each having five hundred plots (25 rows × 20 columns). From each of these portions sampling was carried out on 1 per cent., 2 per cent., 5 per cent. and 7 per cent. basis by the following three methods: (1) Selecting 5′ × 5′ ultimate plots at random; (2) forming composite samples of 125 sq. ft. by adding the yields of five ultimate plots selected at random; (3) selecting an area of 125 sq. ft. adjoining and round about an ultimate plot taken at random. Each method of sampling was repeated twenty-five times. It will be noted that the whole area was sampled 300 times (25 samples × 3 methods × 4 percentages).

Tables I, II and III give the mean values of (*i*) the estimates, (*ii*) the variances within blocks and (*iii*) the percentage loss in efficiency with their standard errors based on the twenty-five samplings. Table IV shows the standard error of the differences between the estimated and the actual values on the basis of the standard deviation without taking the blocks into consideration.

TABLE I

Mean of sampling estimates in ounces for 125 sq. ft. for different sampling methods

Method of sampling	1%	2%	5%	7%
1st method	84·6 ± ·43	84·0 ± ·48	84·4 ± ·24	84·4 ± ·25
2nd method	83·2 ± ·78	84·8 ± ·42	84·8 ± ·29	86·6 ± ·61
3rd method	84·4 ± ·63	84·4 ± ·71	85·3 ± ·45	84·8 ± ·37

TABLE II

Mean variance within blocks for different sampling methods

Method of sampling	1%	2%
1st method	206·8 ± 16·0	230·6 ± 10·7
2nd method	*	29·2 ± 3·1
3rd method	*	149·8 ± 24·4

Method of sampling	5%	7%
1st method	222·2 ± 6·4	222·2 ± 6·2
2nd method	45·6 ± 2·4	99·6 ± 15·8
3rd method	131·9 ± 9·2	104·1 ± 4·1

* There was only one sample in each block.

TABLE III

Percentage loss in efficiency for different sampling methods

Method of sampling	1%	2%	5%	7%
1st method	57·8→7·1	58·7±5·5	30·8±3·1	24·7±3·4
2nd method	*	43·3±6·4	33·4±3·1	43·4±6·5
3rd method	*	72·4±5·8	63·7±5·6	47·9±5·4

* There was only one sample in each block.

TABLE IV

Standard errors of the estimates for different sampling methods

Method of sampling	1%	2%	5%	7%
1st method	2·16	2·36	1·16	1·20
2nd method	3·89	2·09	1·40	2·92
3rd method	3·11	3·53	2·20	1·80

An examination of the above tables leads to the following conclusions:—

(1) The averages of the estimates are almost the same for the various methods of sampling. The standard error of these averages is for all practical purposes a minimum for the first and second methods of sampling on 5 per cent. basis.

(2) The variance within blocks is minimum for the second method of sampling on 2 per cent. and 5 per cent. bases.

(3) The percentage loss in efficiency is low for the first and second methods of sampling on 5 per cent. basis. It is also low for the first method on 7 per cent. basis.

(4) The standard errors of the estimates are comparatively low for the first and the second methods on 5 per cent. basis. It is low for the first method on 7 per cent basis also.

On the whole the present investigations indicate that 5 per cent. sampling by either the first or the second method is likely to give results with comparatively low error. The first method involves more labour for threshing than the second one and hence in actual practice the latter is preferable to the former.

Imperial Agricultural Research Institute, New Delhi, May 19, 1943.

P. V. KRISHNA IYER.
S. AZIZUDDIN AHMAD.

1. Wishart and Sanders, *Principles and Practice of Field Experimentation*, Emp. Cotton Growing Corporation, p. 44. 2. Yates and Zacopany, *J. Agri. Sci.*, **25**, 545. 3. Hudson, *Ibid.*, **29**, 76. 4. Kalamkar, *et al.*, *Curr. Sci.*, **5**, 533. 5. Hubback, *Agri. Res. Inst. Pusa Bull.*, No. 16. 6. Krishna Iyer, *Ind. J. Agri. Sci.*, **12**, 240.

SILURUS COCHINCHINENSIS C.V. FROM MYSORE STATE

COMMENTING on a collection of fishes from Kadur District, Mysore State, Bhimachar and Subba Rau[1] recently referred the species of *Silurus* found on the Western Ghats to *Silurus cochinchinensis* C.V. They pointed out that the variability found in the number of mandibular barbels in the species of *Silurus* is due to the absorption of one of the pairs with the growth of the fish and that it has no taxonomic significance. Based on this conclusion Day's *S. wynaadensis* was considered as a synonym of *S. cochinchinensis* C.V. Hora[2] considered this a valuable observation since it indicates the occurrence of one and the same species in Cochin-China, Southern China, Siam, Malay Peninsula, Burma, Assam, Eastern Himalayas and Peninsular India. This fish represents one of the important Far Eastern elements in the fish fauna of Peninsular India. Its occurrence on the Western Ghats is an important evidence in favour of the "Satpura Trend" theory of Hora.

There are two specimens of *Silurus cochinchinensis* C.V. in our collection of fishes recently made from the hill streams of Western Ghats about two and a half miles from Kottigehar. They were collected in a drainage draining towards the west and in association with *Nemachilus striatus* Day and *Bhavania annandalei* Hora. They measure 111 mm. and 70 mm. respectively in standard length. While the former has only a single anterior pair of mandibular barbels the latter has, in addition, a partially absorbed one of the posterior pair, that on the right side. The left posterior barbel is completely absorbed. This finding confirms the observation made by Bhimachar and Subba Rau.

Fisheries Section, Department of Agriculture, Bangalore, August 5, 1943.

B. S. BHIMACHAR.
AUGUSTINE DAVID.

1. Bhimachar, B. S., and Subba Rau, A., *Journ. Mysore Univ.*, 1941 (B). 2. Hora, S. L., *Rec. Ind. Mus.*, 1942, **44**, Part II, 193.

REVIEWS

The Technique of Radio Design. By E. E. Zepler. (Chapman and Hall, London), 1943. Pp. xii + 311. 21*sh*. net.

Receiver design has now developed into a highly skilled art. Most of the circuits and their peculiarities are patented. In some cases, the design peculiarities are kept so secret that only an expert service engineer can get an idea of such peculiarities after carefully handling the receivers. Consequently, the literature on the subject is scanty and is made available only in the technical pamphlets issued by the manufacturers. The book under review is an attempt to give a very elementary introduction to the subject. It abounds in numerical examples, a feature that is most welcome in books on design.

The book is divided into fifteen chapters dealing with a.c. theory, the different stages of a modern receiver and such peculiarities as selectivity, noise, screening, hum, feed-back, distortion, parasitic resonances, and power supply. There is a chapter on routine measurements and one on fault-finding. The treatment in every chapter is very clear and lucid. The subject-matter of each chapter is most logically and systematically presented. The experience of the author as a research engineer has enabled him to mention a few interesting points in every chapter and this is perhaps the one reason for the reviewer to commend the book. The printing and get-up of the book are excellent.

None of the topics treated in the book comes up for an exhaustive or complete treatment. Many of the chapters are rather defective from the point of view of a design engineer. The materials in chapters on routine measurements and fault-finding will be considered out of date for a book written in 1943. The approach to the whole problem seems to be solely based on the author's experience. This method of handling the problem may be unacceptable. Tre reviewer may perhaps suggest two alternative methods more universally recognised: (*a*) designing from the point of view of catering to a price market and (*b*) designing from the point of view of high fidelity reception, good selectivity and sensitivity, and easy and systematic servicing. The author has made no attempt to establish distinct criteria for either point of view and follow them up.

S. V. Chandrashekhar Aiya.

Chromatographic Adsorption Analysis. By Harold H. Strain. (Interscience Publishers, Inc., New York, N.Y.), 1942. Pp. x + 227. 37 Illustrations. Price $3.75.

It was in 1906, that Tswett devised a simple and ingenious method of adsorption analysis which was destined to play an important role in the advancement of many and varied a branch of science. To quote the picturesque language of Tswett, "Like the light radiations in the spectrum, so is a mixture of pigments systematically separated on the calcium carbonate column into its constituents, which can then be qualitatively and quantitatively determined". The method has since been extended to mixtures of constituents which are colourless.

In cases where the orthodox methods of separation, isolation and purification have failed, chromatographic methods have proved successful. The ease, elegance and simplicity of the method and the inexpensiveness of the equipment for carrying out the technique, are factors which have favoured its extensive employment in various branches of science.

The possibilities of the technique and its application have by no means been fully explored; its applications to industry are still in a stage of infancy. There are still a good number of potentially valuable adsorbents whose adsorbabilities and specificities have yet to be determined, while the fundamental aspects of the method need elucidation.

The volume under review is a valuable contribution to the subject, written by one who has added to the field by his own researches. In a series of nine chapters, the author has covered the entire field; the last chapter is devoted to a discussion of the industrial applications of the method so far known. Practical details of the technique, the choice of adsorbents, solvents and eluants, methods of locating colourless constituents in adsorbed columns, are all discussed in sufficient detail. The volume is a treatise which will not only introduce the investigator to this fruitful technique but also inspire him to achieve greater advances in the practice and application of this method of analysis.

The Indian Sugar Industry. 1942 Annual. Editor: M. P. Gandhi. (Gandhi & Co., Publishers, Fort, Bombay), 1943. Pp. lxvi + 133. Price 5-14-0.

The sugar industry in India is now firmly established as a major industry and is the second largest national industry—second only to the cotton textiles. The protection afforded has been fully utilised to expand it from a moderate size in 1932, when India was a sugar importing country depending upon Java and other places for its requirement of sugar to the extent of ten lakhs tons, to its present status when it can consider exports after meeting her internal demands. But no attempt was made to stabilise the industry and organise it on sound and scientific lines. By-product industries have not been developed. There has been a lack of foresight in not promoting the production of alcohol from molasses. War or peace, to India especially, power alcohol has great potentialities. She has yet to start her automobile industry and she could as well design and manufacture engines for burning alcohol. If the quantity of molasses is insufficient other sources of power alcohol can be developed. Plants for manufacturing rectified spirits and power alcohol need not be imported.

The entire plant can be fabricated in India. A few power alcohol plants have already been constructed in India and are expected to go into operation shortly.

The Indian sugar industry has sprung into prominence suddenly with the loss of the Far Eastern producing centres. India is now free to export sugar by sea. The outstanding feature of the year has been the assumption of control by the Government of the prices and distribution of the total sugar production in British India. The serious position created by the shortage of sulphur is bound to affect the quality of the sugar and consumers must be prepared to take in 'Brown sugar'. Mr. Gandhi has taken great pains in editing the present annual which is the VII volume. It gives a survey of the progress of the industry during the year. Various legislative enactments and Government *communiques* pertaining to the industry have been included besides numerous useful statistical tables. The present problems of the sugar industry and its future prospects have been discussed including the question of post-war reconstruction, 'the discussion of which seems to be a fashion of the day'. The suggestion to replace cane gur and sugar by the products obtained from the palmyra, thereby releasing a considerable area of good agricultural land for growing food crops, is very interesting. With a little care statements such as '... alcohol being a solvent would take the dust along with it, and it may cause starting trouble' (p. 98) could have been eliminated from the book. The Appendix 1, which is referred to in the Preface and Contents as giving a list of sugar factories in India, is missing. The *Annual* continues to be a most comprehensive and very useful reference book on various aspects of Indian sugar industry.

B. N. DAS.

SCIENCE NOTES AND NEWS

Post-War Reconstruction.—At a meeting of the Central Committee of the All-India Manufacturers' Organisation, Sir M. Visvesvaraya, the President, reviewed the progress of the organisation for the second quarter of the current year. Emphasising the importance of immediately taking up the task of proper post-war planning, he declared that no complete picture of the needs of the country could be presented until they knew in what shape or form and to what extent, political power was to be transferred to them after the war. "Unless full responsible Government is secured", Sir Visvesvaraya said, "there is no prospect of a satisfactory solution of all our major problems". After enumerating certain suggestions for immediate and post-war planning, such as a five-year plan, with a capital expenditure of at least Rs. 1,000 crores for the establishment of heavy and key industries, presided over by a Minister or Member of the Government, collection of proper production statistics, and compulsory mass education, Sir Visvesvaraya added that all his suggestions assumed that a National Government would soon be a *fait accompli,* and that the Reconstruction Committee or its Chairman had been made aware of the intentions of the Government in that respect to guide the Committee in shaping its plans.

With regard to post-war reconstruction, Sir Visvesvaraya said that no consistent policy or activity was noticeable in the attitude of the Government. A Consultative Committee of Economists was appointed in October 1941, along with four or five subsidiary Committees to deal with that question. Within the past few weeks, it was reported that a new Reconstruction Committee composed of members of the Viceroy's Executive Council, who would decide all questions of policy relating to reconstruction, had been set up. The earlier Consultative Committee of Economists seemed to have done no work, and Government had offered no explanation as to why the previous arrangement had broken down.

Concluding, he said, that there was talent in the country, which could be profitably utilised to shape reconstruction. There were more university graduates in India than in all the British Isles. In those circumstances, there could be no justification for not associating representative citizens both with the work of planning, and in the execution of reconstruction policies, so necessary to make them acceptable to the great bulk of the country's population.

Improvement of Livestock.—Addressing the staff of the Imperial Veterinary Research Institute of Izatnagar, H. E. the Viceroy emphasised the importance of Veterinary Research for livestock improvement. He said, "I think you all know how deep has been my concern for the advancement of research work in the veterinary field, ever since I first made an intensive study of India's needs, when I was Chairman of the Royal Commission on Agriculture. As Viceroy for seven and a half years, I have watched your progress with sympathy and interest, and I should like to assure you what very high importance I attach to the work which you are doing." Concluding he declared, "Sound livestock improvement must be based on three major sciences, animal genetics, animal nutrition and animal medicine, all of which are now provided for at Mukteswar and Izatnagar. If individual research workers play their part, there is every reason to anticipate in the not too distant future great advances of lasting importance, and I can think of nothing that is likely to be of greater benefit to the Indian cultivator and to India at large."

Penicillin in Canada.—Canada's Government has approved expenditure for the establishment of plants and equipment in Montreal and Taranto for the production of Penicillin, the new bacteria-killing drug.

An appreciation just made will cover the cost of creating the industry and production of the first 26,000,000,000 units of penicillin for use by Canadian armed forces. This constitutes the largest single order for medical supplies which has so far been placed by the Department of Munitions Supply.

According to Mr. C. D. Howe, Minister of Munitions, the new industry by the middle of April will be producing a weekly average of 500,000 units of penicillin. This drug, which is a British discovery, is believed to be ideal for fighting war wounds, pneumonia, blood poisoning and certain other diseases.

New Uses for Jute.—Jute in cloth form has long been used as a material for packing all kinds of articles, but recently jute in a new form has come into the market in the shape of a material suitable for packing and protecting articles during transit. According to the *Bulletin of the Indian Central Jute Committee* (Aug. 1943), a new fabric has been patented by Messrs. Simpson & Munro Ltd., 4, Lyons Range, Calcutta, and consists of laths of wood 1″ × ⅛″ woven into the cloth. The material presents the appearance of a sun-blind and may even be used for this purpose. It is very flexible and can be wrapped round any article down to ¾″ in diameter, thus affording complete protection to the surface of articles during transit.

SEISMOLOGICAL NOTES

No earthquake shocks besides a few very minor seismic disturbances were recorded by the seismographs in the Colaba Observatory, Bombay, during the month of August 1943.

MAGNETIC NOTES

Magnetic conditions during August 1943 were more distributed than in the previous month. There were 5 *quiet* days, 20 days of *slight* disturbance and 6 days of *moderate* disturbance as against 10 quiet days, 20 days of slight disturbance and one of great disturbance during the same month last year.

The quietest day during August 1943 was the 11th and the day of the largest disturbance was the 30th.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days	
	Slight	Moderate
11, 12, 22, 23, 27.	1–7, 9, 10, 14–18, 20, 21, 24–26, 29.	8, 13, 19, 28, 30, 31.

One moderate disturbance with a gradual commencement was recorded during the month of August 1943 while none occurred during the same month last year.

The mean character figure for the month of August was 1·03 as against 0·71 for August last year.

M. V. SIVARAMAKRISHNAN.

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"Science and Culture," Vol. 9, No. 3.

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CURRENT SCIENCE

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BIOLOGICAL STANDARDISATION OF DRUGS

INTRODUCTION

VOLTAIRE defined 'therapeutics' as the pouring of drugs, of which one knows nothing, into a patient, of whom one knows less. Much water has flowed under the bridges since the above statement was made and fundamental advances have taken place in our knowledge of the chemistry and pharmacology of drugs as well as in the symptomatology and pathology of many disease processes in human beings. But the ancient sneer of Voltaire still expresses the general truth that there are *two variables* in therapeutics—the *patient* and the *drug*. As is well known, it is impossible to control two independent variables and, therefore, it is necessary to see which of the two we can standardise to our advantage. With regard to the *patient*, it is important to realise that no two individuals respond to any drug in an identical manner. Leaving aside certain abnormal cases of hypersensitiveness or idiosyncrasy so frequently met with in medical practice, considerable amount of evidence is available to show that there is a wide individual variation even in healthy individuals in the dose of a drug needed to produce an equal effect. If healthy patients do not react in an uniform manner, it is too much to expect that *diseased* human beings, on whom drugs are ordinarily intended to be employed, would respond uniformly. Such being the case, it is futile to attempt to standardise the patient. The only alternative, therefore, in the interest of the safety of patients and to ensure accuracy in therapeutics, is to standardise the other variable—*the drug.*

PHYSICAL, CHEMICAL AND PHARMACOGNOSTIC ASSAY

How can this standardisation be effected? The accurate use of drugs in therapeutics involves that the amount of the active principles given in each dose must be known or, at any rate, must not be subject to irregular variations. The majority of drugs that are used today are derived from vegetable, mineral and animal sources, and the estimation of the active ingredients in each of them can usually be done by the employment of well-known physical and chemical methods. In the case of vegetable remedies, a combination of botanical and chemical methods are often found adequate. Accepted methods for the standardisation of most of the drugs in common use are given in the recognised pharmacopœias, *e.g.*, the British Pharmacopœia, British Pharmaceutical Codex, the United States Pharmacopœia, the National Formulary, etc., and these methods can be easily employed by all laboratories engaged in the standardisation of drugs, medicinal, chemical, insecticides, cosmetics, etc.

BIOLOGICAL ASSAY

During the present century a group of potent substances, *e.g.*, hormones, vitamins, biological substances, etc., have been introduced into therapeutics whose active constituents are insufficiently known or when known, cannot be easily isolated quantitatively. Some of them are potentially dangerous and in many cases, for their safe and effective use, they must be administered by precise dosage. Since these cannot be assayed by chemical means, other methods depending upon their action on intact living animals or surviving isolated organs or tissues have to be adopted.

In the devising of these methods, advantage is taken of the fact that each of the substances exhibits *specific* biological properties. Thus, insulin administered to animals causes a reduction in the concentration of the blood sugar, old tuberculin produces a typical and specific

action when injected into tuberculous animals, administration of the vitamins to suitably-prepared animals will restore growth, cure scurvy, rickets and other diseased conditions, many of which can be experimentally produced in animals, and so on.

The principle underlying biological assay, as distinguished from chemical assay, is that a certain quantity of a drug will always produce the same degree of deflection from the normal in the same animal or in animals of the same species. This is not always absolutely true, for many conditions may alter the extent to which an animal reacts to a drug, and every precaution must be taken to keep all conditions identical in carrying out these tests. For example, the reaction varies inversely with the weight of the animals, and these must be taken as nearly identical as possible, and the dose must be calculated in terms of the weight of the animal. When great accuracy is required, the test must be done upon a series of animals sufficient to eliminate the variations and idiosyncrasies that cannot be controlled under ordinary circumstances.

The Importance and Scope of Biological Assay

The first official recognition of bio-assay was made in the ninth revision of the United States Pharmacopœia, 1916, by the inclusion of a physiological method of standardisation for cannabis and pituitary extracts. Since then, the method has gained steadily in importance and has been extended to a fairly large number of substances including biological products, such as antitoxic sera, vitamin and endocrine preparations, chemical transmitters, *e.g.*, acetylcholine, synthetic compounds, *e.g.*, organic arsenicals and antimonials, chemotherapeutic remedies, *e.g.*, antimalarials, antibactericidals, etc., insecticides, disinfectants and other groups of drugs of the type of digitalis and similar glucosides, ergot, aconite, etc.

Though a comparatively new method of standardisation, the utility and reliability of bio-assay have been established beyond doubt. The recent isolation of various hormones in chemically pure form and the newer ideas regarding the chemical transmission of nerve impulse are some of the fruits of biological assay. Drugs such as insulin or liver extract could not have been brought into clinical use unless it was possible to ensure a uniform product through biological standardisation. This method is also indicated if the chemical assay does not give a true value of the activity of the drugs, even when the active principles are chemically known. Thus, chemical assay may fail to separate optical isomers, such as *l*- and *d*-adrenaline, which differ greatly in their physiological activity. The efficiency of a new remedy may be judged with the action of a known sample by means of biological assay. It has also been found valuable for the detection of small quantities of potent poisons in the body organs, blood or urine. Furthermore, biological assay is needed to supplement chemical assay in order to observe undesirable toxic effect or to gauge efficient therapeutic activity. An example of this is to be seen in the case of the arsphenamine group of drugs. This can be obtained as pure synthetic compounds of known chemical composition but minute differences in their toxicological behaviour have been found to exist from batch to batch. The animal body can detect such differences which are too fine to be identified by chemical or physical tests. On the whole, the great sensitivity of biological assay is an advantage over chemical assay. Thus, we can easily estimate acetylcholine or adrenaline in a dilution of one in one hundred millions or more. At present we do not know of any chemical method to detect or estimate such extraordinarily small quantities.

In spite of its advantages in certain directions, the biological assay methods must be regarded in most cases as merely a 'stop-gap' which allows the strength of drugs to be controlled before the chemical methods have been developed. Biological tests for some vitamins and hormones have already been replaced by physical and chemical methods, and this process will doubtless continue. Thus the preparations of ergot used to be assayed by the B.P. and is still being assayed by the U.S.P., by biological method. The chemistry of the active constituents of ergot are now better known and it has been found possible to standardise it by means of a colorimetric method. In the case of thyroid preparations also, the biological method has been largely replaced by the chemical method which determines the total iodine content of the glands. However, when biological methods and chemical methods for the assay of a pharmacologically active substance disagree so widely that the disagreement cannot be due to the error of the tests (as is sometimes encountered in hormone research) the biological method is, by definition, right and the chemical method must be assumed to be wrong.

Biological Standards and Their 'Units'

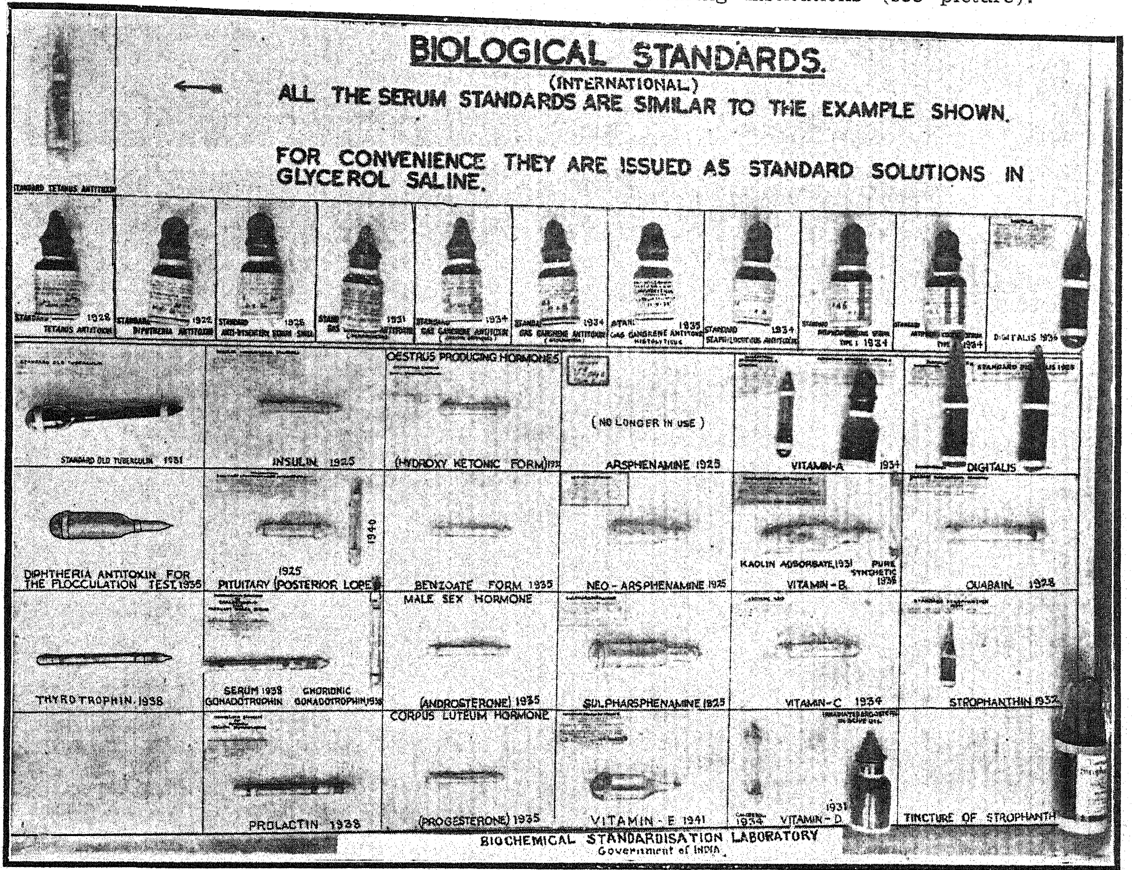
In biological assay, the object is to compare the effects of a preparation with those of a *standard* and whenever possible this standard should be a single, stable and pure chemical substance. For certain vitamins and hormones, for instance, it has already been found possible to take the active substances in chemically pure form as the standard, and to define this by its physical and chemical constants. In the case of adrenaline preparations, for example, there is no prescribed standard. It can be assayed against pure and *l*-adrenaline which is readily obtainable. But this is not always possible and biological standards have often to be employed in cases when a standard in a pure chemical form is not available. Where biological standards are used, the reason is that preparations issued for therapeutic use do not usually contain the active substances in its pure form and are frequently mixtures; so long as these conditions prevail, any method of assay other than the biological will accordingly be unpracticable.

But to have a *standard* preparation is not enough; its action must also be measurable and expressible in terms of a unit of activity. As has already been emphasised, it is not possible to determine the potency of any of these substances by simple observation of the effects

produced in an animal or a small group of animals. It is, however, possible to find out how much of a preparation, the potency of which is unknown, will produce the same biological effect as a definite quantity of another preparation the potency of which is known, provided the tests are carried out under strictly comparable conditions. The recognition of this fact has led to the definition of a biological '*unit*'. This indicates the degree of *specific biological activity contained in a certain weight of the standard.*

International Standards

The decision to have the question of biological standardisation internationally studied was taken by the League of Nations' Health Committee at its second session at Geneva in 1921. In 1924, the Health Committee decided to set up a Permanent Commission on Biological Standardisation consisting of experts from various countries. The Commission decided first, to establish *standard* preparations and second, to select *units* to express their potencies. By international agreement, a number of International Biological Standards have now been established and are available for use all over the world through 'national' distributing centres, so that a common notation and a common standard of reference are available to all research workers, assay laboratories and manufacturing institutions (see picture).



1st Row.—Tetanus Antitoxin (1928); Diphtheria Antitoxin (1922); Anti-Dysentery Serum (Shiga), (1928); Gas Gangrene Antitoxin (Perfringens, 1931); Gas Gangrene Antitoxin (Vibrion Septique, 1934); Gas Gangrene Antitoxin (Oedematiens, 1934); Gas Gangrene Antitoxin (Histolyticus, 1935); Staphylococcus Antitoxin (1934); Anti-Pneumococcus Serum (Type I, 1934); Anti-Pneumococcus Serum (Type II, (1934); Digitalis (1936).

2nd Row.—Old Tuberculin (1931); Insulin (1925); Oestrus-producing Hormones (Hydroxy-ketonic form, 1932); Arsphenamine (1925); Vitamin A (β-Carotene, 1934); Digitalis (1925); Digitalis (Brit. Std.).

3rd Row.—Diphtheria Antitoxin for the Flocculation Test (1935); Pituitary (post lobe) (1925; 1940); Oestrus-producing Hormone Mono-benzoate of Dihydroxy form (1935); Neoarsphenamine (1925); Vitamin B_1 (standard absorption product, 1931) (Pure synthetic, 1938): Ouabain (1928).

4th Row.—Thyrotrophin (1938); Gonadotrophins (Serum, 1938) (Chorionic, 1938); Male Hormone (Androsterone 1935); Sulpharsphenamine (1925); Vitamin C (*l*-Ascorbic acid) (1934); Strophanthin (Brit. Std.).

5th Row.—Prolactin (1938); Corpus Luteum Hormone (Progesterone, 1935); Vitamin E (1941); Vitamin D (Irradiated ergosterol, 1931) (Calciferol, 1934); Tinct. of Strophanthus (Brit. Std.).

Methods of Biological Assay

While the Standards Commission recommended suitable methods, the methods remain open to progressive modification and improvement or discovery of a new method in accordance with experience and research in this field of study. The methods may vary while the activity of the standards is immutable. It is important that the method of assay must be one which measures the important therapeutic principle. Several different methods can be used, provided they measure the same active principle. The result of assay should be the same whatever method is used, and in every case, a 'control' assay should be run with the 'standard', side by side with an unknown sample using the same technique. In general, the methods of biological assay may be divided into two classes:—

(A) *The "All or None" Reaction.*—The 'all or none' biological response indicates that a given reaction is either present or absent. Although perhaps, 'death' occurs more frequently than other end points, the method has been applied to many criteria, such as convulsions, systolic standstill of the heart, the presence of cornified cells in the vaginal epithelium, negative blood smears and survival in a therapeutic test. The biological assay based upon the toxicity test, the assay of œstrogenic hormones and vitamin B are familiar examples of this type of measurement.

(B) *The 'Graded Response' Reaction.*—Another large group of assays depend upon a graded dose-effect response, where the extent of the reaction varies with the dose. Examples are the hypoglycemic response of the rabbit to insulin, the height of contraction of guineapig uterine muscle to posterior pituitary extract, the level of serum calcium in the dog following treatment with parathyroid extract, and the growth of depleted mice under different dosages of vitamin A. Since each individual reaction is quantitative rather than qualitative, it contributes more information per animal than in the preceding type or assay. It is important, however, to choose a dose for the *standard* and for the *unknown* sample, which produces a *median* response. An essential requirement for assay is that equal active doses should produce equal effects. Further, a significant difference in dosage must give rise to an unmistakably different effect.

Sampling Error in Bio-Assays

The most serious difficulty in biological assay is that due to the variability of the 'test objects', *i.e.*, living animals and some of the most serious errors have arisen from a failure to appreciate its true dimension. This error is called the "sampling error". No physiological method has any value which does not eliminate or estimate the animal variations. Two kinds of variation have to be considered: the relatively persistent differences of sensitiveness between one individual and another, and the variations of sensitiveness seen in a single individual from day to day, or in a single isolated organ or tissue during the course of an experiment.

Individual variations can be eliminated when the same animal or organ can be used for successive or alternate tests. But even in this case the variations from one time to another are not eliminated. In fact only too often the animal may become sensitised.

When the assay is carried out on different groups of individuals, the difficulties are greater. It is a common habit to assume that, if the results obtained from three successive animals happen to agree, the right answer has been obtained, further results which do not happen to agree being discarded. Such a habit of discarding some unwelcome figures introduces an error in biological assay. If in ten estimations, for example, nine give reasonable agreement and the tenth is considerably higher, the mere fact that the tenth has occurred means that the true *mean* is a little higher than the figures which apparently agree. The operation of the 'law of averages' is important in biological assay.

Fortunately, the sampling error can be estimated by statistical computation. We can, by employing the well-established laws of mathematics, calculate whether the difference in the average potencies of two samples is merely due to variation in the animals selected or is actually 'significant' ('T' value) and is to be taken into account. Similarly, by applying the computation of 'Probability' ('P' value), we can find the best number of animals to employ in an experiment by which an accurate result can be obtained. However, the mechanism of the physiological action of drugs is of so complex a nature that numerous factors may introduce serious errors in the estimated results. It is easy to familiarize oneself with the technique of bio-assays but it is difficult to eliminate or judge the various errors likely to occur. No biological assay can be considered valid unless it takes into consideration all the principles enunciated above.

Bio-Assay of Drugs in India

With the advice of Sir Henry Dale, F.R.S., N.L., lately Director of the National Institute for Medical Research, London, Prof. R. N. Chopra first introduced biological methods for the standardisation of digitalis preparations in the laboratories of the School of Tropical Medicine, Calcutta. Meanwhile, biological standardisation of sera, vaccines, antitoxins, etc., was being carried out at the Central Research Institute, Kasauli, and at the Haffkine Institute in Bombay. Under the able guidance of Sir Robert McCarrison, the Nutrition Research Institute at Coonoor, South India, also adopted approved methods for bio-assay of vitamins and vitamin products.

The much-needed fillip to the wider employment of standardization procedures in the field of drugs came through the establishment by the Government of India of the Bio-chemical Standardisation Laboratory under the direction of Sir R. N. Chopra. Though far from ideally equipped and not endowed with facilities commensurate with the intensity and importance of the task it is required to tackle, this Laboratory, during the last six years of its existence, has made significant contributions to this difficult field of work and by advice and guidance, has enabled the drug industry in India

to launch newer projects in the manufacture of glandular products and modern chemotherapeutic remedies. Previous to the establishment of the Bio-chemical Standardisation Laboratory, opinion with regard to the physiological potency and therapeutic efficacy of products of this group could only be obtained from Britain, Germany or America. In the present state of India's progress in the field of drug manufacture, there is need for increased emphasis in the direction of biological standardization side by side with the development of synthetic and applied chemistry. There is need also for the development of 'Therapeutic Research Institutes' on the lines of the Nuffield Institute in Oxford where experimental medicine and clinical trial of promising drugs on human patients could be undertaken to supplement observations made in the biological standardization laboratories. Only by such organised efforts can India be made self-sufficient in the matter of her drug supply.

B. MUKERJI.

THE WAY AND SPIRIT OF SCIENCE*

BY GENERALISSIMO CHIANG KAI-SHEK

(*Chairman of the Military Affairs Commission of the Republic of China and Supreme Commander of the Chinese Armies*)

THE SCIENTIFIC APPROACH

PROCEED from the immediate to the distant, from the low to the high; attain the great through the small, the difficult through the simple. To accomplish great and important things, it is necessary to start from the nearest, simplest, and most minute matters, enlarging and expanding gradually in systematic order.

Competence in small things preceeds competence for big affairs; first know how to do commonplace things well; afterwards talk of doing work of special importance. Know how to solve small and easy problems; afterwards you may be successful in rare accomplishments. Never run after speculations and far-reaching conclusions, missing out immediate stages and hoping for lucky shots. Your work will only be superficial; short cuts will not lead to the desired aim, and nothing solid will be accomplished.

THE SCIENTIFIC SPIRIT

In order to investigate thoroughly all the phenomena of man and Nature, our attitude towards anything should be, not only to attempt understanding of what is not understood, and to make experiments where the previous experiments have not been satisfactory; but also to understand further what is commonly supposed to be already understood, and to improve further those experiments which have already been commonly considered satisfactory. The more knowledge grows, the more the lack of it is felt. The greater one's accomplishment, the more intensely the smallness of one's ability is realized. But it is through this very feeling of inadequacy and insignificance that knowledge and achievements can continually progress.

Never be satisfied with obtaining one result or even a small success. Whatever be the department of knowledge one is investigating or whatever kind of work one is to do, it is necessary before starting to consider properly the facts of the case, avoid all vagueness in defining the aim and be sure about the method to be employed. Once started, be determined to carry the project through, working unceasingly and meeting every obstacle with undaunted resource.

Many young men of to-day have no understanding of this principle. They will start to study a subject or work on a project, but when they meet the slightest obstacle or disappointment, instead of holding on doggedly and industriously, they will merely skip the difficulty and turn over to some other easier problem. This mental unsteadiness, chopping and changing time after time, will never bring any result.

There are also many who have as their main object in life the attainment of wealth or high official position, and if they find themselves engaged in work where these aims seem to have little or no hope of realization, they will discard it without any consideration, however important it may be, and creep into some new path. Such opportunists, consulting only their own selfish interests, have no responsibility to the country and the people.

THE SCIENTIFIC SYSTEM

Limitations. In doing anything we must first know the limitations of the question; in other words, one must be quite clear about one's object and aim. This is of prime necessity, for one can then concentrate time and energy upon possibilities within the frame of reference. Thus one can avoid all distractions from other sources; and one will not try to do several things at once. If we think of attacking one problem to-day, another tomorrow, and still another the day after to-morrow, finally nothing will be accomplished. In investigations and affairs it is essential to define the central idea. Only if this is done can we distinguish between the roots and branches of things, avoiding confusion between the first and the last. A clear idea of the order of things, which stands the test of practice, is required for the success of any research.

Management. All reasonable scientific organization must satisfy the following requirements: (*a*) a vertical definite dendritic order; (*b*) a horizontal intimate co-ordination. The vertical order embodies the relation between

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* Abridgment of an address by Generalissimo Chiang Kai-shek, given in 1942; translated by Huang Hsing-Tsung and Dr. Joseph Needham, F.R.S. Note that the word "Way" has a special significance in Chinese philosophy. The address is posted in all Chinese Government laboratories and workshops.

the upper and the lower, the deriving to the derived, levels of organization. Such relation must be well understood before the organization can be effectively controlled and steered with ease. The horizontal co-ordination embodies the relation between each small part of the organization to every other part, so as to give harmony in operation. Such relations must be intimate before the different portions can achieve complete co-ordination, and the organization run with maximum efficiency.

Recording and Preparation. Before beginning work on any subject, collect every type of material available, examine it carefully, and presuppose all possible situations which may be encountered at different later stages, using all possible intelligence and resourcefulness. Consider the preparation of different types of formulæ to meet different situations so that at any stage of the work the most satisfactory formula can be produced. Only those who are thoroughly industrious and persevering in thought, only those who have different solutions and formulæ prepared beforehand, can meet every situation with calmness and ease. However difficult the matter in hand may be, in the end they find the solution which carries them through.

Division of Labour and Co-operation. The advance of human civilization has been entirely due to division of labour and co-operation. Whether it be knowledge or practical affairs, division of labour is necessary for specialization, and co-operation is necessary for success. For the intelligence and ability of one single man are limited; hence each man has to select a particular branch of knowledge for investigation or a special type of practical work to do; only then is the highest efficiency attained. Then the results of different investigations have to be unified and co-ordinated, and the entire whole of knowledge and achievements makes real progress. We Chinese suffer from a great lack of co-operation in knowledge and affairs. In our scholarly researches there is not enough discussion and mutual understanding; and in our affairs there is little sympathetic and helpful co-ordination; thus the research spirit is low and few things are done well and effectively.

Research. The progress of science and the improvement of the lot of man have been due to the efforts of research. These were not accomplished by people who are content to work to strict office hours. In the West, work is carried on not only in the normal working hours, but even free time is not wasted. For example, Sundays have been found just the right time for intellectual investigations. If we are to save our country, we must break through the present lethargic and pessimistic psychology, and cultivate an industrious and persevering spirit, dedicating oneself to research with all one's heart and mind.

Experimentation. Many of the results of investigation and observation are only theories which have to stand the test of experiment before it can be shown whether they are correct and suitable for practical purposes. If experimentation shows flaws in the theory, then it is necessary (according to the facts of the case) to study more carefully, trying various improvements until as satisfactory a hypothesis is obtained as possible. If one still fails, the reasons for failure must be further inquired into, and corrections made accordingly. The ideal type of research worker is one who stands firmly by the scientific attitude (the objective outlook), observes facts and circumstances objectively and with humility, and draws his conclusions therefrom. Then only will there be any hope of knowing the truth.

Analysis and Statistics. When any plan or project of work shows development at the experimental stage, whether good or bad, one must collect and analyse the mass of material on hand, find out where the defects or good points are, decide whether the plan is workable and how far progress has been made, and in which direction and along what lines future developments are to take place. This statistical and analytical ability and the power for precise decision are fundamental in the success or failure of our research or practical work. Without the analytical and decisive mind it will not be possible to see clearly and objectively the relevant facts, and one falls into a mental state of chaos and disorder, failing to discover any likely approach to a successful conclusion.

Improvements and Inventions. To be conscious of mistakes is the most important factor in making progress. So in all our analytical examinations it is imperative to find the causes of these mistakes; only in this way shall we be able to find the required improvements. We must also persevere to discover those new principles, new methods, and new factors which are essential for general progress.

Conclusions. We live in an era of difficulty, suffering and danger. To be able to shoulder the heavy responsibility of reviving our nation and completing our revolution, we must have at all costs a clear idea of the content and meaning or science; we must propagate the spirit of science; and we must utilize the methods of science; so that one man will be as efficient as ten, and in one day ten days' work will be done. While we are fighting intensely at the front for the mode of life we want, we cannot remain stationary at home; if we do not progress we shall degenerate; if we cannot achieve success we shall be ruined; if we do not prosper we shall be crushed; if we still refuse to gather our full strength our very existence will become impossible. From this day onwards, whatever it is we have to do, and whoever is doing it, there should be no more inefficient half-heartedness and no more spirit of fatalistic resignation.

—(*Courtesy of "Nature"*, 152, 1943, 118.)

MUSLIM BLOOD GROUPS WITH PARTICULAR REFERENCE TO THE U.P.

By D. N. MAJUMDAR
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RECENTLY blood groups of Muslims have been determined at Calcutta by Macfarlane, and Greval and Chandra. The former grouped 120 Muslims from Budge Budge (24 Parganas) and 136 urban Muslims from Calcutta, and the latter 321 mostly urban Muslims in connection with the blood transfusion service of Calcutta.

About 400 Muslim students at Lucknow have been grouped by me. The denomination Shia and Sunni were either given by the students or assigned by my Muslim colleagues. Doubtful cases were excluded. When two brothers were found to belong to the same group one of them was excluded from calculation.

The accompanying three tables give the blood groups of the Muslim students of the Lucknow University, representing the U.P. Muslims, and those of their co-religionists in other localities further east and west geographically.

TABLE I

Blood Groups of Muslims of the U.P.

	O	A	B	AB
Muslims (326) ..	34·1	23·0	33·7	9·2
Shia Muslims (106) ..	35·8	25·5	33·7	4·7
Sunni Muslims (220)	33·2	21·8	37·7	9·2

TABLE II

Blood Groups of Muslims and Their Gene Frequencies

	O+A	P	*q*	*r*	Author
(1) Turks	74·80	·256	·135	·607	Hirschfeld
(2) Arabs	72·00	·238	·151	·616	Altounyan
(3) Syrian Muslims ..	84·90	·252	·081	·669	Boyd and Boyd
(4) Tunis Muslims ..	78·88	·211	·112	·681	Caillou and Disdier
(5) Pathans	60·60	·209	·222	·541	Malone and Lahiri
(6) Hazaras	57·00	·157	·254	·566	do.
(7) U.P. Muslims ..	57·10	·177	·245	·584	Majumdar
(8) "Shias"	61·30	·165	·218	·598	do.
(9) "Sunnis"	55·00	·159	·259	·575	do.
(10) Budge Budge Mohamedans	51·60	·174	·282	·582	Macfarlane
(11) Urban Mohamedans ..	62·50	·200	·209	·572	do.
(12) Calcutta Mohamedans ..	54·10	·188	·264	·543	Greval and Chandra

TABLE III

Blood Groups (contd.)

	B+AB	O	A	B	AB	Author
(1) Turks (500)	25·20	36·80	38·00	18·60	6·60	Hirschfeld
(2) Syrian Arabs (1,149) ..	28·00	38·00	34·00	20·00	8·00	Altounyan
(3) Syrian Muslims (199) ..	15·10	44·70	40·20	11·60	3·50	Boyd and Boyd
(4) Tunis Mohamedans (500) ..	21·20	46·40	32·40	15·80	5·40	Caillou and Disdier
(5) Pathans (150) .. →..	39·40	29·30	31·30	33·30	6·10	Malone and Lahiri
(6) Hazaras (100)	43·00	32·00	25·00	39·00	4·00	do.
(7) U.P. Muslims (326) ..	42·90	34·10	23·00	33·70	9·20	Majumdar
(8) "Shias" (106)	38·70	35·80	25·50	34·00	4·70	do.
(9) "Sunnis" (200)	46·90	33·20	21·80	37·70	9·20	do.
(10) Budge Budge Mohamedans (120)	48·30	28·30	23·30	40·00	8·30	Macfarlane
(11) Urban Mohamedans (136) ..	37·50	33·10	29·40	30·90	6·60	do.
(12) Calcutta Mohamedans (321)	45·70	29·50	24·60	36·40	9·30	Greval and Chandra

Tables I, II and III do not need any explanation. A casual inspection of these figures will show how far the Muslims of India serologically stand with respect to their colleagues in other parts. The Muslims of Budge Budge (24 Pargs., Bengal) and of all Bengal (Greval and Chandra) show difference from the U.P. Muslims, both the Shias and Sunnis, the former being more remote than the latter. As we proceed from Western India to the east, the O percentage decreases from 35·80 (Shias) to 29·50 (all Bengal: Greval and Chandra), while the percentage of B increases from 33 to 40 in the case of the Muslims of Budge Budge. If we add B + AB, the Sunnis of U.P. (46·90) stand nearer to the Mohammedans of Budge Budge (48·30) as well as to those from all Bengal (45·70) though in the absence of details about distribution of the latter we do not know how far they are representative of Bengal Muslims. The Pathans, Shias and the Hazaras do not show even 40 per cent. B + AB.

The Muslims of Bengal and the depressed castes of the same area, show similar blood groups percentage (Macfarlane). The latter comprise Pod, Bagdi, Namo, Mal and Rajvanshi (75) showing 29·3 O, 22·7 A, 42·7 B and 5·3 AB. Again Macfarlane's non-caste Hindus, comprising the artisan and depressed groups (320), recorded 30·9 O, 22·2 A, 40·0 B and 6·9 AB. The large percentage of O among the Muslims of U.P. and a lower incidence of B show perhaps a higher degree of isolation or ethnic purity of the upcountry Muslims. This is corroborated by the percentage distribution of blood groups among the urban Muslims (Macfarlane) who belong to Bengal as well as to upcountry centres, more to the latter, I suppose. Again the low value for B among the Muslim population outside India and also very high incidence of A distinguish these from Indian Muslims. A critical study of the data along with those now being collected will be presented in a separate paper to be published elsewhere.

I am indebted to the authorities of the Shia Intermediate College, Christian College, Isabella Thoburn College for Girls, and Canning College.

1. Greval and Chandra, "Blood Groups of Communities in Calcutta," *Ind. J. Med. Res.*, 1940, **27**, 1109-16. 2. Macfarlane, E. W. E., "Intercaste differences in blood groups distribution in Bengal," *Abs. Proc. 25th Indian Sc. Congress*, Part III, 199-200. 3. —, "Blood-groups distribution in India with Special Reference to Bengal," *J. of Genetics*, July, 1938, **39**, No. 2, 225-37. 4. Boyd, W. & L., "Blood Groups and Inbreeding in Syria," *Am. J. Phys. Anth.*, 1941, **28**, 318ff. 5. Gates, R. R., "Recent Progress in Blood Group Investigations," *Genetica*, 1935, **18**, 47-65. 6. Majumdar, D. N., "Blood Groups of Criminal Tribes," *Science and Culture*, **8**, 334 ff. 7. —, "Blood Groups of the Doms," *Curr. Sci.*, **2**, 153-54. 8. Chatterjee, B. K., and Mitra, A. K., "Blood Group Distribution of the Bengalis and their comparison with other Indian races and caste," *Indian Culture*, **8**, No. 223, 1-21.

SUBSTITUTES IN WAR AND PEACE

ACCORDING to *Nature*, 1943, 152, 184, Doctor C. H. Desch, in a brochure entitled "Substitute materials in war and peace", invites attention to some of the less well-known facts: In the autumn of 1941, Germany was using producer-gas for running 150,000 lorries; many more were on order and also 20,000 new agricultural tractors with the same means of propulsion. In the United States, synthetic resins have become even scarcer than the aluminium they were designed to replace. An artificial fibre, made entirely from coal, limestone and chlorine, has been made in Germany since 1939; it is used for protective clothing, fishing nets and chemical filters. Some 10,000 tons of 'fodder yeast', first made on a large scale in Germany during 1914-18, was being produced at Regensburg in 1939. Nickel in the Axis countries has been largely replaced by chromium and molybdenum, obtained within occupied regions. There is no evidence that the quality of German aircraft is suffering in any way from lack of suitable alloy steels, but for steel-making there is probably a shortage of manganese, for which no satisfactory substitute is known.

In Great Britain much economy has been effected by reducing the number of steel specifications from 2,000-3,000 to 85, and further reduction is possible. Copper and 'stainless' steel for making resistant chemical plant have been economized by using mild steel with a surface-layer of the more valuable metal, rolled on to it during the manufacture of the plates. Difficulties have been encountered in finding a satisfactory substitute for tin in making tin-plate and for bearings. In the United States, plants are being constructed to produce annually 800,000 tons of synthetic rubber from petrol and 200,000 tons from alcohol, prepared from grain. Japan is said to be using her superabundance of rubber by distilling it to produce petrol. Of all substitutes now in use, synthetic resins are considered to have the greatest probability of a survival, and as mineral resources gradually decline, as they inevitably must, greater use will be made of substitutes, and particularly of those which can be produced from the renewable raw materials provided by Nature.

LETTERS TO THE EDITOR

OXIDATION BY $KHSO_4$ AS A DISTINGUISHING FEATURE BETWEEN AMPHIBOLES AND PYROXENES

In the course of my investigations, while fusing a Cummingtonite (an iron amphibole) with $KHSO_4$, I observed that the mineral got very black and, on examination, this was found to be accompanied by the oxidation of a considerable proportion of its FeO into Fe_2O_3. On fusing with $KHSO_4$ a pyroxene, more or less similar in composition to the amphibole referred to above, it was found that oxidation of its FeO had taken place, but markedly to a less extent. To ascertain the implications of this difference in the degree of oxidation between amphiboles and pyroxenes, a few more pairs of these two classes of minerals, each pair more or less corresponding in composition, were fused with $KHSO_4$; and, from the

TABLE OF RESULTS

Sl. No.	Sample Nos.	Amphibole or Pyroxene	Constituents in the sample		FeO% after $KHSO_4$ treatment	FeO% of col. (*f*) calculated as percentages of FeO% col. (*d*)
			FeO%	MgO%		
a	*b*	*c*	*d*	*e*	*f*	*g*
1	Z_3/488	Amphibole (Cummingtonite)	39·16	4·65	2·46	6·28
2	M_2/845	Pyroxene (Hypersthene)	38·65	7·57	21·65	56·01
3	R/239	Amphibole (Cummingtonite)	22·23	16·41	14·15	63·65
4	M_2/803	Pyroxene (Hypersthene)	18·42	22·59	18·22	98·91
5	H_9/217	Pyroxene (Hypersthene)	31·71	13·00	25·41	80·13
6	M_2/753	Pyroxene (Hypersthene)	30·15	9·36	18·53	61·48
7	M_2/873	Amphibole (Cummingtonite)	34·29	9·67	2·30	6·71
8	K/868	Amphibole (Hornblende)	13·11	10·36	6·36	48·51
9	Nil	Amphibole	26·57	15·31	7·85	29·54
10	Nil	Amphibole	7·64	10·80	0·59	7·72
11	L/223	Pyroxene	41·14	7·14	21·86	53·14

results obtained so far, as shown in the following tabular statement, it is evident that the proportion of the FeO oxidised to Fe_2O_3 in amphiboles is decidedly and considerably higher than in the pyroxenes of similar composition.

In the table above, in all the samples, only the FeO and MgO values are given, as these are the important constituents besides SiO_2. But sample No. 8 contains also 12·76 per cent. CaO and 10·15 per cent. Al_2O_3, and No. 10, 15·07 per cent. Fe_2O_3 and 6·90 per cent. Na_2O.

The degree of this oxidation may be modified to some extent by the other oxides present in the mineral like MgO, CaO, etc. The presence of a high proportion of MgO lowers the degree of oxidation as may be seen by comparing the analytical results of amphiboles, Nos. 1, 3, 7 and 9; and of pyroxenes, Nos. 2, 4, 5, 6 and 11. In pyroxene No. 4, where the proportion of MgO to FeO is high, the oxidation is very little. But, in amphiboles, Nos. 8 and 10, though the proportion of MgO to FeO is high, yet the degree of oxidation is large. This may be due to the influence of considerable amounts of Al_2O_3 and CaO present in No. 8, and of Na_2O and Fe_2O_3 present in No. 10. The fusions, in all cases, were carried out at about the same temperature, for the same period of time and using powders of about the same fineness.

The relative difference between the amphiboles and pyroxenes in the degree of oxidation of their FeO seems to be dependent upon their crystal structure. Further investigations are in progress and the results will be published in detail elsewhere.

M. R. ANANTHANARAYANA IYER.
Mysore Geological Dept.,
Bangalore,
August 30, 1943.

THE IODINE CONTENT OF THE THYROID GLANDS OF SOUTH INDIAN ANIMALS

DURING the course of our investigations (1941-1942) on the preparation of thyroid extracts, under the auspices of the Board of Scientific and Industrial Research, the remarkable observation was made that the desiccated thyroid prepared from the local animals was much higher in iodine content than the continental specimens. These observations, which were published as a brief note in the *Review of the Technical Work of the Board of Scientific and Industrial Research*,[1] have now been independently confirmed by Dr. Mukerji,[2] of the Biochemical Standardisation Laboratory, who has found that the thyroxine iodine contents of desiccated samples prepared in India are, as a rule, higher than those of foreign specimens.

The values that we obtained for the Total and Thyroxine Iodine contents of desiccated thyroids of cattle, sheep and pig, analysed by standard methods,[3] are given in the following table (No. I), the experiments being carried out with South Indian animals exclusively:—

TABLE I

Chemical Assay of Desiccated Thyroid (Per cent. by weight of desiccated gland)

	Total Iodine	Thyroxine Iodine
Beef thyroid ..	0·91	0·35
Sheep thyroid ..	0·66	0·26
Pig thyroid ..	0·84	0·39

The average weights of the thyroid as well as of other glands like adrenal and pituitary of Indian animals are definitely smaller than those of the corresponding glands of European and American animals. In the case of the thyroid glands, however, the total iodine content is considerably higher, amounting to as much as 0·91 per cent. for beef glands. Kendall, who first isolated thyroxine in a pure and crystalline condition, worked with desiccated hog glands, the total iodine content of which was as low as 0·21-0·34 per cent.[4] and Harington made use of desiccated thyroid having an iodine content of 0·5 per cent.[5] for his classical researches on the isolation and study of the chemistry of thyroxine. It is also a well-known fact that several specimens of American thyroid are so low in iodine, that they cannot conform to the B.P. standard, which insists on having a thyroxine iodine content of 0·1 per cent.

It is generally agreed that the amount of iodine in the thyroid gland is dependent on the iodine content of the diet. The high iodine content of the thyroids of the South Indian animals must, therefore, be attributed to the high level of iodine in drinking water and in the vegetable kingdom here. It is also in conformity with the striking fact that endemic goitrous regions are practically unknown in South India.

This research scheme was financed entirely by the Board of Scientific and Industrial Research, to whom our grateful thanks are due.

Chemistry Department, Presidency College, Madras.
B. B. DEY.
P. S. KRISHNAN.
M. GIRIRAJ.
September 1, 1943.

1. *Curr. Sci.*, 1942, **11**, 171. 2. Mukerji, *Curr. Sci.*, 1943, **12**, 256. 3. *British Pharmacopœa*, 1932 and *Addendum*, 1936. 4. Kendall, *Thyroxine*, 1929. 5. Harington, *The Thyroid Gland*, 1933.

CHEMICAL INVESTIGATION OF SEED OIL OF *MORINGA CONCANENSIS*

Moringa concanensis (Gujarati: "Kadavo Sargavo") is a medium type of tree glabrous except the young parts and the inflorescence and grows almost everywhere in Gujarat. The tree bears fruits in the form of capsules which are straight, acutely constricted between the seeds on an average 1 to 1½ ft. long. Each capsule contains several seeds. These seeds are white or pale yellow.[1] These seeds on

extraction with ether give on an average 38 per cent. of yellowish coloured oil. The oil, besides its use in medicine, can very well be used to lubricate delicate machinery. On finding that these types of trees are abundant on this side and the oil available would also be abundant, and in view of the above uses, it was thought advisable to carry out the chemical investigation of the same oil.

The oil has a faint pleasant odour and shows the following characteristics:—

Refractive index at 40° C. = 1·4624.
Acid value (in terms of oleic acid) = 2·61.
Saponification value = 189·3.
Iodine value (Wij's method) = 79·25.
R.M. value = 0·57.
P. value = 0·26.
Acetyl value = 23·1.
Unsaponifiable matter = 1·095.

The examination of the component fatty acids of the oil is in progress.

Industrial Chemist's Laboratory,
Baroda, C. B. PATEL.
September 4, 1943.

1. *The Flora of the Presidency of Bombay*, **1**, Part 2, 283; and *Watt's Dictionary Econ. Prod.*, **5**, 275.

VARIATION IN THE MEASURABLE CHARACTERS OF COTTON FIBRES: A NOTE ON THE VARIATION BETWEEN FIRST AND SECOND FLUSH OF BOLLS

IN the Coimbatore tract the normal pickings of cotton end by April. If, however, showers of rain fall in time a second flush of flowers is produced which gives a supplementary picking somewhere in June. It was thought interesting to compare the fibre properties of the pickings made from the two flushes. Seven strains of *G. hirsutum* which were grown at the Cotton Breeding Station, Coimbatore, were utilised for this enquiry. It should be mentioned that in the normal pickings, the quantity of good *kapas* was a large percentage of the total. In the summer picking, however, it formed about a fifth or a fourth of the whole. For the study of the properties only the good *kapas* from the bulk was utilised. The results obtained are given in Table I.

TABLE I
Results (Mean of 7 Values)

Property	Normal	Summer	Difference Normal–Summer
Seed weight (mgm.)	107·4	99·3	+ 8·1
Lint weight (mgm.)	63·1	45·1	+18·0
Ginning percentage	37·0	31·2	+ 5·8
Mean length (inch)	0·924	0·844	+ 0·080
Fibre weight per cm. (10^{-6} gm.)	1·483	1·323	+ 0·160
Standard fibre weight (10^{-6} gm.)	1·753	1·570	+ 0·183
No. of fibres per seed (1000's)	18·39	16·40	+ 1·99
Mature fibres %	56·29	57·43	− 1·14
Immature fibres %	16·00	17·59	− 1·59

It will be seen that the seed weight is higher for the normal picking by 8·1 mgm. on the average which is highly significant. The lint weight and ginning percentage are similarly higher by 18·0 mgm. and 5·8 per cent. respectively. The mean fibre length and the number of fibres per seed are significantly higher for the normal picking by 0·080" and 1,990 respectively. The fibre weight per cm. as well as the standard fibre weight are similarly higher by 0·160 and 0·183 units respectively. The difference in the maturity, however, is not significant.

It will be seen that on the whole the summer picking exhibits considerable deterioration, excepting in fineness and maturity, as compared with the normal picking. This result, it will be recalled, is for the good *kapas* only which forms about a fourth or fifth of the whole picking. Even this good portion shows such a deterioration; the quality of the whole picking should be considerably worse indeed.

The cause for the deterioration noted above appears to be, besides the later age of the plant, the severe attack of insect pests. The reduction in the number of fibres per seed and the standard fibre weight appears to be due probably to the higher temperature under which the fibres are produced, as is shown in another place.*

Cotton Breeding Station,
Coimbatore, R. L. N. IYENGAR.
September 1, 1943.

* Iyengar, R. L. N., *I.C.C.C.*, Second Conference, *Report*, 1941, 145-46.

A CASE OF CHLOROPHYLL DEFICIENCY IN SAFFLOWER (*CARTHAMUS TINCTORIUS* L.)

IN the year 1938-39, in the progeny of a plant of I.P. 7 Safflower, 19 plants, out of a total of 98, were observed in which, although the cotyledonary leaves were normal green, the true leaves were chlorophyll-deficient. The chlorophyll deficiency increased gradually from the first true leaf up to the third or fourth leaf. Thereafter the next few leaves were practically white and very much reduced in size. At this stage these plants died.

The ratio of normal green to chlorophyll-deficient plants, as could be seen from the frequencies (79 : 19), was 3 : 1, suggesting that the parent-plant was heterozygous for the gene pair governing chlorophyll deficiency; this heterozygous condition may have resulted from the mutation of one of the dominant alleles of the pair responsible for the normal green condition, to the recessive state.

In order to test the validity of this assumption, the seeds of six normal green plants, picked at random, were harvested and sown separately in the following year (1939-40). Of the six progenies five segregated in a 3 normal green : 1 chlorophyll-deficient plants and one bred true to the normal green condition. Theoretically, four progenies should have segregated and two bred true to green on the basis that the chlorophyll-deficient condition is a simple recessive to the green. The

frrquencies for the individual aggregating cultures are given below:—

TABLE I

Cult. No.	Frequencies		Total	Dev./S.E.
	Normal green	Chlorophyll deficient		
1	65 (60·75)*	16 (20·25)	81	1·09
2	66 (61·50)	16 (20·50)	82	1·15
3	Bred true for the normal green condition			
4	49 (43·50)	9 (14·50)	58	1·65
5	48 (45·00)	12 (15·00)	60	0·89
6	44 (40·50)	10 (13·50)	54	1·10
Total	272 (251·25)	63 (83·75)	335	2·62

* The figures in brackets represent expected frequencies.

Although in each case the fit to a 3 : 1 ratio is good, the fit for the total of all the segregating cultures is bad. This is due to the fact that there is a deficiency in the recessive class in all the segregating families and this deficiency has an accumulated effect in the total.

In order to find out whether it was merely due to chance that all the segregating families were deficient in the recessive class or whether it was due to some genetical or other causes, sowings were repeated with a known number of seeds from each of the above cultures. The data which are reproduced here show that the deficiency of the recessive class in all the segregating families in the initial sowing was merely due to chance.

TABLE II

Cult. No.	Frequencies		Total	Dev./S.E.
	Normal green	Chlorophyll dificient		
1	66 (55·50)	8 (18·50)	74	2·82
2	41 (39·00)	11 (13·00)	52	0·64
4	37 (34·50)	9 (11·50)	46	0·87
5	29 (30·00)	11 (10·00)	40	0·36
6	35 (36·00)	13 (12·00)	48	0·33

These results, therefore, indicate that this type of chlorophyll deficiency in safflower is inherited on a monofactorial basis, the chlorophyll-deficient condition being recessive. Further, this condition appears to have arisen as a result of gene mutation and is perpetuated through plants heterozygous for this character.

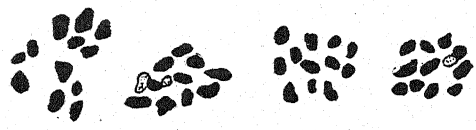
Imperial Agricultural Research Institute, New Delhi,
August 17, 1943.

R. B. DESHPANDE.

FURTHER CHROMOSOME NUMBERS IN THE CÆSALPINIACEÆ

IN this note which is a continuation on the chromosome numbers of Cæsalpiniaceæ,[4,5] the author records the chromosome numbers of the following species as counted during meiosis in pollen mother-cells:—

Amherstia nobilis Wall..
Saraca indica Linn.
Brownea sp. (usually called *B. Hybrida* in the gardens)
} $n = 12$



1 2 3 4

FIG. 1-4

FIG. 1. *Amherstia nobilis*, I metaphase. FIG. 2. The same, II metaphase. FIG. 3. *Brownea hybrida*, I metaphase. FIG. 4. *Saraca indica*, II metaphase.

This number agrees with that reported previously for the genus *Cæsalpinia*,[2,5,7] *Cersis canadensis*,[7] *Cassia fistula*,[8] *C. sophora*,[3] *C. alata*[7] and *C. tomentosa*.[1,6]

The material for this study was obtained from plants cultivated in the Royal Botanic Garden, Calcutta. The author is obliged to the authorities of this Garden for providing all facilities for collection, and to Dr. A. C. Joshi for his help.

Maharaja's College,
Vizianagram,
September 1, 1943.

J. V. PANTULU.

1. Hus, H., *Proc. Calif. Acad. Sci.*, 1904, III Ser., **2**, 329. 2. Jacob, K. T., *Ann. Bot.*, *N.S.*, 1940, **4**, 201. 3. Kawakami, J., *Bot. Mag. Tokyo*, 1930, **44**, 319. 4. Pantulu, J. V., *Curr. Sci.*, 1940, **9**, 416. 5. —, *Ibid.*, 1942, **11**, 152. 6. Saxton, W. T., *Trans. S. Africa Phil. Soc.*, 1907, **18**, 1. 7. Senn, H. A., *Bibliog. Genet.*, 1938, **12**, 175. 8. Tischler, G., "*Allgemeine Pflanzenkaryologie*, Bd. 2, Abt. 1, Teil. 1, 1921–22.

BAICALEIN FROM THE SEEDS OF *OROXYLUM INDICUM* VENT.

DURING the investigation of the seed-oil of *O. indicum* Vent.,[1] one of us (C.R.M.) reported the isolation of a yellow crystalline substance (m.p. 274°) in a quantity which was too small for further investigation.

This work has been continued, and on careful examination of various extracts, we have obtained another yellow crystalline substance (m.p. 265-66°) from the alcohol, acetone and water extracts. Its carbon and hydrogen values, its specific colour reactions and the study of the properties of its demethylation, methylation and acetylation products, which agree closely with those recorded for them in literature,[2,3] indicate it to be a trihydroxy flavone, $C_{15}H_{10}O_5$, $[C_{15}H_7O_2(OH)_3]$, *viz.*, 5 : 6 : 7-trihydroxy flavone or 'Baicalein'. We have further confirmed our conclusion that this substance is baicalein by means of a mixed melting point determination with an authentic sample of baicalein kindly supplied by Prof. Keita Shibata.

Baicalein was isolated from the roots of *Scutellaria baicalensis* Georgi by Shibata, Iwata and Nakamura,[2] and was synthesised by

Bargellini.[3] It is interesting to mention here that baicalein occurs along with Oroxylin-A in the root bark of *O. indicum* Vent.[4]

A detailed account of this investigation will shortly be published elsewhere.

Central Excise Laboratory,
The Technological Institute,
Baroda, C. R. MEHTA.
September 20, 1943. T. P. MEHTA.

1. Mehta, *Proc. Ind. Acad. Sci.*, 1939, **9A**, 390. 2. *Acta Phytochim.*, 1923, **1**, 105. 3. *Gazzetta*, 1919, **49**, ii, 47. 4. Shah, Mehta and Wheeler, *J.C.S.*, 1938, 1555.

INDIAN RHUBARB AS SUBSTITUTE FOR 'OFFICIAL' RHUBARB

Rheum officinale Baillon, *Rheum palmatum* Linné and other species and hybrids of Rheum, grown in *China and Tibet* are the recognised varieties of rhubarb in the British and the U.S. Pharmacopœias. *Rheum emodi* Wall., which grows in the Himalayas at altitudes of 4,000 to 12,000 feet, is commonly believed to be of an inferior grade to the Chinese and Tibetan drug and is not acceptable as a substitute in 'official' medicine.

On the basis of available chemical and pharmacological evidence of earlier workers, Chopra[1] suggested in 1933 that Indian rhubarb, if properly cultivated, could be accepted as an efficient substitute for foreign rhubarb. No systematic work is traceable since to support this statement.

During last year presumably on account of the difficulty of securing Chinese rhubarb, possibilities of a profitable export trade in Indian rhubarb have developed and repeated enquiries have been referred to this department with a view to utilising Indian rhubarb in official pharmacopœial preparations. A pharmacognostic, chemical and pharmacological investigation was, therefore, started with seven different varieties of Indian rhubarb obtained from localities such as Sikkim, Assam, Nepal, Kashmir, etc., and though the enquiry is still progressing, the following observations may be recorded.

1. PHARMACOGNOSTIC EXAMINATION

(*a*) *Comparative Anatomical Structure.*—A study of the comparative anatomical structure of *R. palmatum* Linn., *R. officinale* Baill., and *R. emodi* Wall., shows that vascular bundles, xylem vessels, medullary rays and cell contents are more or less the same in all the three varieties except with minor variation. The distinguishing characters are total absence of star spots and presence of lignified xylem vessels in *R. emodi* Wall., *R. officinale* Baill., resembles more or less *R. palmatum* Linn. in botanical characteristics.

(*b*) *Comparative Characteristics of Rhubarb Powder.*—

Chinese Rhubarb	European Rhubarb	Indian Rhubarb
Colour—Brownish Yellow	Bright yellow	Brownish yellow
Odour—Faint	Very faint	Fragrant
Characteristic features—Numerous calcium oxalate crystals, starch abundant, vessels non-lignified	Same as in Chinese rhubarb	Numerous calcium oxalate crystals, starch abundant, vessels lignified

2. CHEMICAL EXAMINATION

Official Rhubarb—
(*a*) *Alcohol* (45 p.c.)—soluble extractive—not less than 35 p.c.
(*b*) Other organic matter—not more than 2 p.c.
(*c*) Acid-insoluble ash—not more than 1 p.c.
(*d*) Emodin and chrysophanic acid—present.

Indian Rhubarb—
(*a*) Average—35·5 p.c.
(*b*) Slightly more than 2 p.c.
(*c*) From 0·6 to 1 p.c.
(*d*) Present.

3. PHARMACOLOGICAL EXAMINATION

Equivalent weights of the dry powder of an official variety of rhubarb and an Indian variety of rhubarb (with more or less similar analytical data) were administered to cats by stomach tube and their purgative effects observed. The method employed was too crude to enable a comparative quantitative evaluation possible but in general it may be stated that the Indian variety showed a satisfactory purgative effect.

Further data are being gathered for a detailed report elsewhere but the evidence points to the fact that at least certain varieties of Indian rhubarb* (cultivated variety as distinguished from the wildly growing species) may also be recognised in the Pharmacopœias for medicinal use provided they conform to the specifications laid down in the B.P. and/or U.S.P. The darker colour, coarser texture and minor differences in pharmacognostic characteristics of the Indian rhubarb need not necessarily mean that it is inferior in its content of therapeutically-active principles.

In this combined study, help was received from Mr. A. B. Bose (Pharmacognostic study), Messrs. G. K. Roy and R. C. Guha (Chemical study) and Dr. N. K. Dutt (Pharmacological study).

Specimens of powedered rhubarb ('official' varieties) were obtained through the courtesy of Mr. J. K. Lahiri of the Department of Chemistry, School of Tropical Medicine.

Bio-Chemical Standardisation
Laboratory, Govt. of India,
Calcutta/Kasauli,
August 16, 1943. B. MUKERJI.

* Two varieties of Indian Rhubarb have been found *not to conform to B.P.* specifications. Attempt is being made to identify these varieties.

1. Chopra, *Indigenous Drugs of India*, 1933, p. 235, Art Press, Calcutta.

PRELIMINARY NOTE ON THE PERFECT STAGE OF *EPHELIS ORYZAE* SYD. [*BALANSIA ORYZAE* (SYD.) COMB. NOV.]

Ephelis Oryzæ Syd. is a well-known parasite in the paddy-growing regions of South India, sometimes causing heavy damage. The type material on the basis of which Sydow erected the species *E. Oryzæ* was collected by McRae near Telungupalayam, Madras Presidency. The disease manifests itself in the inflorescence, where in the place of normal healthy grains, a gelatinous mass of spores which dries up into a greyish-white horny crust, is observed. In many cases the inflorescence fails to emerge out of the boot due to severe infection. The conidiospores are formed within the pycnidia differentiated from the mycelium. As development proceeds, the entire endosperm is destroyed, leaving a black hyphal mass covered by the persistent glumes. The conidiospores are acicular measuring $22\text{-}38 \times 1\ \mu$.

After the dispersal of the conidiospores, the grains become shrivelled up and spongy in texture. Some of these grains were collected, washed in sterile distilled water thoroughly, and placed in petri dishes containing moist silver sand, previously sterilized. Small bits of the material were often tested to study further developmental stages.

The formation of perfect stage was observed in many of the grains after 30 to 45 days. From the mycelium a clavate stipe measuring up to 0·5 mm. in length, cinnamon yellow in colour, with a sphæridium, was formed

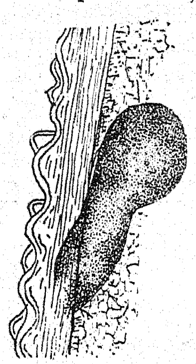


FIG. 1. Stipitate stroma with the spheridium × 200.

(Fig. 1). The stromata could be made out when the enveloping glumes were dissected out. Perithecia were ovate to cylindric and immature. The lack of true sclerotia and other characters clearly indicate that the fungus is a species of *Balansia*. It essentially differs with regard to conidiospore measurements and other characters, from other species of *Balansia* so far recorded. The perfect stage having been observed, a new combination *Balansia Oryzæ* (Syd.) Narasimhan *et* Thirumalachar is proposed. A formal description of the species will be published separately.

Instances of the discovery of *Balansia* stage of species of *Ephelis* are known. Weber[2] for instance collected overwintering sclerotia of *Ephelis mexicana* which, on germination, developed stromata as in *Balansia hypoxylon*. Sydow[1] who recorded *Balansia Andropogonis* on *Andropogon aciculata* from India, stated that *Ephelis palladia* Pat. common in Tonkin and the Philippines, is doubtless the conidial stage.

Bangalore, M. J. NARASIMHAN.
September 9, 1943. M. J. THIRUMALACHAR.

1. Sydow, H., and P., and Butler, E. J., *Ann. Mycol.*, 1911, **9**, 395. 2. Weber, G. F., *Phytopathology*, 1924, **14**.

ON THE EXTERNAL MORPHOLOGY OF THE LARVA OF THE GLOW-WORM, *DIAPHANES* SP. (LAMPY: COL.)

THE following description is prepared from a collection sent to me in February 1942 from Pampadampara Estate, S. India. I am deeply thankful to J. C. M. Gardner, Forest Entomologist, Dehra Dun, for helping me in identifying the larvæ. The collection consisted of only two larvæ besides males and so far as I know a detailed account of the external morphology of this form is not available. In fact, our present knowledge of Lampyridæ is very meagre and the larvæ as well as females of several species remain still undescribed.

Length—About 40 mm.

Colour—Dark brown.

Tergal plates are distinct, rugose and mid-dorsally sulcate, sulcations being feeble in the last two plates.

Head is black, prognathous, depressed and completely retractile into the prothorax. Head-capsule is incomplete beneath, where it leaves a gap in which is placed the labiomaxillary plate. The Y-shaped epicranial suture is impressed dorsally and represented internally by strong ridges. The eyes are anterior and lateral, immediately behind the antennæ, which are retractile into the extensive antacoria. Antenna is 3-jointed, apical joint being very small and papilla-like while the sub-apical as well as basal are long with few tactile setæ. The basal joint is very long and almost retracted into the head. Anterior margin of the head-capsule is continued beyond the antennal base and it gives off on each side a rounded process which probably represents the precoila which exactly fits into a slight concave depression or preartis on the dorsal aspect of the base of the mandible. The precoila of each side bears a very conspicuous long spine. Another very long spine springs from immediately behind each antenna. Clypeus is deeply and widely foveate medially. Ventrally the gena of the head-capsule is produced anteriorly into a genal process, the postcoila, whose apical surface bears an acetabulum which receives the condylar postartis of the mandible. The genal process runs anteriorly and inwards, its outer margin forming the ventral border for the antennal base. Dorsally the base of the antenna is bordered by the margin of the precoila. The mandible is strongly falcate with the basal half broad and flattened inwards. The broad basal area of the mandible is

produced anteriorly into another strongly falcate secondary tooth, the retinaculum. The mandible is pierced by a long canal whose external opening is sub-terminal and internal opening placed at the base just internal to the pre-articular acetabulum. Ventrally just outside the internal opening of the mandibular canal is the rounded post-articular condyle which articulates with the genal acetabulum. The inner border of the mandibular base is beset with a very fine brush of hairs. There is also a large tuft of stiff hairs forming a conspicuous sheath at the base of the mandible. The mandible is finely pubescent on the ventral side. The labio-maxillary plate is formed by the median labium and the lateral maxillæ. The Cardo is small and sub-quadrate with the posterior and outer borders straight and the inner border slightly convex. The stipes is very large, stout, basally narrowed and carries distally the maxillary palp. The maxillary palp is 4-jointed, the basal joint being the longest and almost as large as all the remaining joints put together. The second and third are very narrow while the apical is least chitinised, strongly compressed and bears a sensory streak. All the joints carry setæ, some of which are very long. Each stipes bears ventrally four long spines. Just on the inner side of each maxillary palp is the two-jointed galea, whose stout basal joint bears a long ventral supporting process and the small apical joint carries a very long spine. Lacinia is in the form of a brush supported by sclerites and presents a sharp cutting tooth for the animal. It is placed dorsally and both face each other. On the inner side it is supported by a triangular sclerite whose apex is attached to the inner border of the stipes. Dorsally it is supported by a broad sclerite whose anterior end is pointed, posterior and inner margins convex and outer margin concave. The narrow labium is differentiated anteriorly into a prelabium which carries the two palpigers bearing the labial palpi. Each labial palp is 2-jointed, the distal joint being narrow, slender and tactile. Dorsally the prelabium carries a white brush formed of fine bristles. The postlabium is formed of a single elongate flask-shaped sclerite which represents probably the fused mentum and sub-mentum. The dilated basal region of the sclerite carries two long symmetrically placed spines.

Thorax.—Pronotum is longer than broad, anteriorly narrowed and anterolateral margins rounded. The median longitudinal sulcus terminates anteriorly in a very slight notch. Lateral margins are straight and the disc is raised medially and strongly punctate. The posterolateral angles are tipped with yellow. The lateral margin is raised into a *marginal carina*. The area between the disc and marginal carina is depressed. The mesonotum is nearly as long as broad and sub-quadrate with a *lateral carina* on either side of the disc. Lateral margins are sub-parallel. The median longitudinal sulcus is present. The anterior notch is conspicuous. Posterolateral angles are tipped with yellow. The metanotum is slightly broader than long and sub-quadrate with both lateral and marginal carinæ. Anterior notch is well formed and posterior border convex. There are three pairs of thoracic legs. Coxa is black, long and cylindrical. Trochanter is large and very feebly constricted. The coxo-trochanteral joint is distinctly dicondylic and conspicuously creamy white. Distal half of the trochanter is brownish and setose. Femur is long and cylindrical and carries ventrally a median light brown line which is continuous with a similar line on the distal half of the trochanter as well. On either side of this line is a row of spines, which are longer and stouter and more on the distal half than on the basal. The tibiotarsus is slightly shorter than femur and carries on the inner surface a profuse growth of very long and strong spines. The femur and tibiotarsus are black except at the femoro-tibio tarsal joint which is creamy white. The tibiotarsus is narrowed distally into a pale rufous area which bears a strong single claw. At the base of the claw is another pair of small lateral claws. Both coxa and femur carry on their outer surface a faint longitudinal streak.

Abdomen.—The tergal plates are distinct, rugose and mid-dorsally sulcate, sulcations being feeble in the last two plates. There are nine visible abdominal terga. The abdominal terga 1-7 are all broader than long, anteriorly narrowed, posterior margin more or less convex, posterolateral angles tipped with yellow and longitudinally sulcate. The lateral carinæ are broken up into irregular pits and elevations. Eighth tergum is without the disc and lateral carinæ. Median sulcus is feeble, lateral margins yellow and the anterior and posterior border slightly concave. Ninth tergum is strongly concave posteriorly and the median sulcus is feeble. The lateral carinæ are absent but the posterolateral angles are sharply pointed and each carries a cluster of about five pale rufous flexible pointed spines. The sternal plates are devoid of the movable sternal spines so abundant in *Lamprophorus* larvæ. The abdominal sterna are provided with a row of from four to eight pale reddish brown spots on each side. These spots vary considerably in number and arrangement as evident from the following table:—

Abdominal sterna	Larva I		Larva II	
	Right	Left	Right	Left
I	8	6	6	5
II	8	8	8	8
III	8	6	6	6
IV	6	6	6	5
V	6	7	7	7
VI	6	6	6	6
VII	6	7	4	6
VIII & IX	Indistinct			

A median ochreous basal streak is present in the abdominal sterna V to VIII. Eighth sternum is sub-triangular and bears two pairs of blunt processes, the outer posterolateral and the inner posterior which is smaller than the former. The ninth sternum is very narrow,

Typically four pairs of pleurites are present in each abdominal segment. A long narrow plate almost touching the tergum but separated from it by distinct suture, forms the dorsalmost plate. The second is small but more or less continuous with the spiracle bearing third plate. The spiracle is borne anteriorly but the posterior surface is studded with a cluster of about a dozen round spots. Ventral to the spiracular pleurite is another narrow strip close to the sternum. The eighth pair of spiracular pleurites are eburated and photogenic.

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August 10, 1943.

RIVER MEANDERING AND THE EARTH'S ROTATION

THE literature dealing with rivers is full of conflicting explanations of the origin of meanders in unrestricted natural rivers. Geologists and geomorphologists often explain the occurrence of the sinuosities and the associated phenomena in terms of the earth's rotation, which is well-known as Baer's Law or Coriolis' Effect.

If ω be the angular velocity of the earth's rotation and λ the latitude of the place, a water body with mean velocity U_m will be acted upon by a deviating force of magnitude $2\,\omega \sin \lambda\, \bar{U}_m$ per unit mass, which, it is quite easy to show, acts at right angles to the flow direction and is to the right in the northern hemisphere and to the left in the southern hemisphere. And as the tendency of some of the rivers flowing in the two respective hemispheres is towards developing curves in the above sense, it is argued that the earth's rotation is the cause of river meandering.

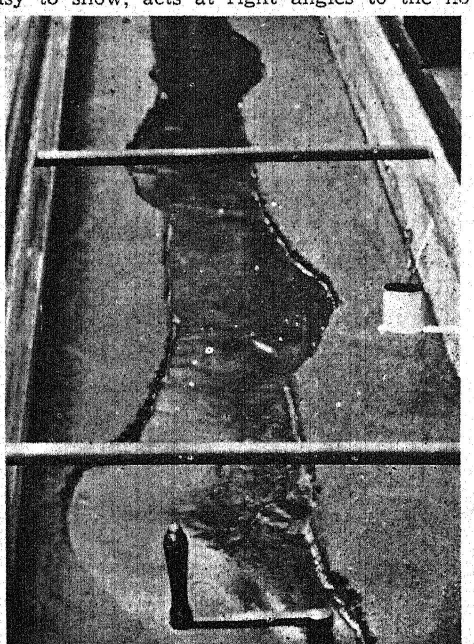

FIG. 1.—The Meandering Stream

However carefully conducted experiments by the writer at the Hydraulics Laboratory of the Imperial College of Science and Technology, London, show that the predominance of curves on the left or the right is merely a chance phenomenon, having hardly anything to do with the terrestrial rotation.

Fig. 1 is the photograph of a stream with well-developed curves situated alternately to the left and the right and the water is seen flowing smoothly through it. The channel had initially been moulded straight in an incoherent sand of mean grain diameter 0·70 mm., with the mean velocity equal to about 30 cm./sec., the sediment to water discharge ratio equal to about 1 : 700 and the width to depth ratio of the order of 20·0.

Before the bights arose, the stream bed changed into skew shoals such as are illustrated in Fig. 2, where the arrows depict the direction and the manner of motion of the sediment particles. Observations showed the particle paths to be inclined at an angle of from 45° to 60° to the main flow direction. So, transversely, a drag varying between 1 and 1·732 times the drag in the flow direction, must have acted upon the particles.

← *Direction of Flow*

FIG. 2.—Illustrating the Skew Shoals

Taking $\lambda = 51°\ 31{\cdot}1'$ (value for the University of London), we find that a unit mass of water under the influence of the deviating force will describe a circular path whose radius of curvature is $2{\cdot}626 \times 10^5$ cm. So there will be a transverse gradient roughly equal to 1 : 300,000. The drag arising out of this is, however, seen to be quite trivial compared with even 50 gm./m.^{2} required for general motion of the particles in the flow direction.[1]

To increase the effect, a channel with transverse slope 3,000 as great, *i.e.*, 1 : 100, but with less slope and less sediment to discharge ratio, was run for about four hours. It failed to produce skew shoals or even any regular bights.

So, if the model experiments are any clue to large-scale phenomena, which ought to be the case, the conclusion is strongly against the terrestrial rotation being taken as the cause of river meandering.

Jamnadas Dewanmal Road,
Ratan Talao,
Karachi, MOHD. SALEH QURAISHY.
August 10, 1943.

1. Quraishy, M. S., *J. Univ. Bomb. Phys. Sci. No.*, Nov. 1943 (being published).

VIRUS DISEASES OF POTATOES IN INDIA

WHEN intensive investigations on breeding better potato varieties for India were taken up in 1935, it was realised that little improvement was possible if the manifold fungal, bacterial and virus diseases which affect this crop, were not taken into account from the very outset. This was particuarly true of virus diseases which cause more permanent damage than others and lead to the rapid degeneration of varieties.

In 1935 a preliminary survey, both in the hills and the plains, was made and tubers collected from plants which appeared to be diseased by virus. Judging by symptomatology alone, ten types were separated, but the progenies of selected diseased plants gave rise in many cases to different symptoms and in others to healthy plants. As an insect-proof house necessary for such work was not available other arrangements had to be made for the identification of at least the more important virus diseases present in the plains of India where the problem is very acute. An opportunity for obtaining such co-operation of the Potato Virus Research Station, Cambridge, presented itself in 1938 when Dr. R. N. Salaman, F.R.S., kindly agreed to identify them if tubers from diseased plants were sent to him to Cambridge. Tubers from seven apparently "mosaic-diseased" plants of the Phulwa variety were sent in 1938 and another lot of 25 samples in 1939.

Unfortunately, the second and more important lot of samples got accidentally destroyed but from an examination of the first set, Dr. Salaman concluded that they were suffering from a chronic infection with Y virus (*Solanum* virus 2), which was confirmed by inoculation to tobacco, *Datura* and *Capsicum*, the latter two giving negative results.

Phulwa (= Patna White) is an important commercial variety cultivated in the plains, possessing good keeping qualities and relative freedom from disease, though in parts of the U.P., it gets severely attacked by this virus. Symptoms of affected plants are given below:

Plants dwarfed; leaves much reduced, distorted and wrinkled; leaflets cupped upward, rarely downward, owing to growth ceasing at edges but continuing in the middle; margins wavy, uneven; mottling veinal and intraveinal, covering large areas or entire leaflets, except midrib which remains green throughout; reddish pigment in all leaves at margin, spreading inwards; texture of leaf rendered medium hard but without necrotic spots or streaking. Yield and tuber size much reduced.

Potato virus Y is transmitted by the aphis *Myzus persicæ* (Sulz.) and by sap inoculation. It is inactivated at 52° C. and by the drying of the leaves, according to Holmes.[2] The use of virus-free seed tubers and careful roguing of diseased plants have given considerable success as will be evident from the results obtained at Delhi with commercial Phulwa 'seed' and tabulated below (Table I): —

TABLE I

Counts of diseased plants on three successive occasions at monthly intervals, first count being forty days after planting.

	First count		Second count		Third count	
	Total plants	Per cent. diseased	Total plants	Per cent. diseased	Total plants	Per cent. diseased
a	802	5·2	826	7·5	826	9·4
b	796	9·8	798	16·8	798	19·8
c	783	16·1	760	24·9	760	28·2

a = tubers from apparently healthy plants after roguing.
b = tubers from field where no roguing was done.
c = tubers from diseased plants.

TABLE II

Counts of diseased plants when planting was done on four different dates.

Planting date	Total plants	Per cent. diseased
Sept. 15 ..	339	31·3
Oct. 1 .	371	35·6
Oct. 15 .	470	4·9
Nov. 1 ..	260	7·3

The diseased plants in the first count were evidently due to tuber infection and show that roguing, even though done late in the previous season, is effective. The incidence of disease is considerably affected by the time of planting also, as will be manifest from data recorded in Table II.

It was noted that all tubers from an affected plant did not give diseased plants: When single plant progenies were grown separately, usually only 50 to 60 per cent. of the resulting plants showed disease. It may be added that this disease affects other commercial varieties also, similar symptoms having been observed in Darjeeling, Red Round, etc.

Apart from the above, the only other potato virus disease occurring in India, that has been definitely identified, is leaf-roll (*Solanum* virus 14). Its symptoms are highly characteristic and confirmation of its occurrence was obtained when material sent to Dr. Salaman for varietal identification was found to suffer from it.

Thanks are due to Dr. Salaman and to Dr. B. B. Mundkur for their help.

Imperial Agricultural Research Institute, New Delhi, B. P. PAL.
August 7, 1943.

1. Smith, Kenneth, M., *Plant Viruses : II. Tabulæ Biologicæ*, 1939, **17**, 60–66. 2. Holmes, F. O., *Handbook of Phytopathogenic Viruses*, Minneapolis, 1939.

REVIEWS

Social Studies and World Citizenship. By L. J. F. Brimble and F. J. May. (Macmillan & Co., Ltd., London), 1943. Pp. 158. Price 6 *sh*.

Not only teachers, but those parents who take more than superficial interest in the spiritual welfare of their children may profit by this wholesome and stimulating book, which aims at social unity and internationality. Adopting Canon Leeson's definition of citizenship as an activity of the personality to secure certain benefits for the community to which the citizen belongs, the authors proceed from the foundation of their thesis to guiding teachers in the application of history, geography, literature and science to a realisation of world citizenship by their pupils. For instance, of history they say that the most important attitude of mind to be gained from its study is the concept of progress through co-operation, and of the retrograde steps which follow aggression and self-seeking.

Geography they recognise as an effective discipline for promoting sympathetic understanding between individuals, and between different groups of individuals. Literature and science, like the arts, are already international, but this aspect of them can be further developed in the direction of biography; and in the case of music by radio. The book is refreshingly free from political bias, and from slogans. Here is no holiday from planning, but in so far as the authors are themselves planners, they seem to know that without goodwill the most elaborate plans are predestined to failure, whilst with goodwill the most artless may succeed. They know also that civic duty begins in the life of the family; and while claiming that the whole of our youth education should have a religious, as opposed to an agnostic background, they would base it on rational observation, not on emotional feelings and mythical beliefs.

Controversy is invited only when dealing with world citizenship in relation to the language problem. Accepting the desirability of an international auxiliary language, they agree with the British Association Committee of 1921 in condemning adoption of any national modern language because it would confer undue advantages and excite jealousy. To some, that might have the air of pandering to the very vice they seek to destroy—supernationalism; because, whatever the attractions of a synthetic language like esperanto may be, the fact remains that English is mother-tongue to more people than any other one language, and is already the second language of many millions more. For those who find the British people distasteful there are always the Americans in counterpoise, and the conventional whine about English spelling derives from a widespread misapprehension, namely, that you spell by memory. Actually, you spell mainly by observation: you know when a word "looks right" and correct it when it "looks wrong". For example, my reactions to the authors' "Leibniz" were (1) it looks wrong, and then (2) the common spelling is "Leibnitz": they did not begin with remembering the common spelling. Thus the habitually reviled English spelling is not so much a super-tax on memory as a vast gymnasium of observational exercise; and incidentally a mine of history.

M. O. F.

The Cathode-Ray Oscillograph in Industry.—By W. Wilson, D.SC., B.E., M.I.E.E. (Chapman and Hall, London), 1943. Pp. 160. 156 Figs. Price 12*sh*. 6*d*. net.

Of all the modern instruments which the experimental physicist created for his investigations none has found so extensive and increasing a use in almost all the branches of science and engineering as the Cathode-Ray Oscillograph either in its usual form or with some modifications. It has become an indispensable test instrument in electrical industries. Considering its importance, therefore, not many books have been published on it and the present volume written primarily for the industrial user forms a useful addition to their existing list.

The book consists of 12 chapters and one Appendix. Of these the first three are devoted to a general description of the assembly and a detailed description of its component parts and accessory circuits, their functions and alternative forms. The modern types of the Cathode-Ray equipments as available to the industry are then described at some length—particularly the Cossor and Du Mont sets in the glass tube variety and the Cambridge Oscillograph using a metal tube. Various kinds of tests and observations that can be carried out with these instruments are given with practical examples and records obtained from actual industrial applications in each case.

A chapter is devoted to a description of the electron microscope and the diffraction camera as they are cathode-ray tubes based on the same general principles but curiously one does not find any mention of the Iconoscope or allied tubes. The final chapter gives some constructional details with a view to help the worker carry out any minor repairs. General outlines of vacuum tubes, photoelectric cells and piezoelectric crystals are given in the Appendix.

The book is profusely illustrated with numerous photographic reproductions and neat circuit diagrams.

The treatment is rather concise for the standard of the average worker whom the author has kept in mind; and the worker may find it unclear at some places. Mathematics is avoided to make room for practical aspects.

This is not always an advantage for no amount of descriptive matter can have the unambiguous meaning of a mathematical statement.

On the whole the book will be found quite useful by workers in the electrical industries and by students who wish to be familiar with the practical uses to which the Cathode-Ray Oscillograph is put in industry.

N. B. BHATT.

Manometric Methods. By Malcolm Dixon. (Cambridge University Press, London), 1943. Second Edition. Pp. xiv + 155. Price 8/6.

It is a decade since the first edition of this book was written; during the period, this little book has inspired and guided successive batches of students of biochemistry in the adoption and experimentation of manometric technique which constitutes one of the most convenient, elegant, accurate, and widely practised methods of measurement in biochemical research.

Since the publication of the first edition, several refinements and improvements in the method have been effected; its applications have been extended. Micro and ultra-micro adaptations of the technique, capable of measuring volume changes of the order of one-millionth of a cubic centimetre, have been developed. The second edition, under review has been revised in the light of these developments.

Adequate recognition has not been given to Dr. Linderstrøm-Lang, who has been entirely responsible for developing the cartesian diver ultra-micrometer. From the volume one gains the impression that Dr. Linderstrøm-Lang was responsible only for the "suggestion"; it should, however, be added that the experimental technique and the applications of this ultra micro method were all thoroughly worked out at the Carlsberg laboratories in 1937 when the reviewer was working there.

The list of some further applications of manometric methods, the three appendices giving examples of standard experiments, and the table logarithms, add to the usefulness of the book.

The Application of Absorption Spectra in the Study of Vitamins, Hormones and Co-enzymes. By R. A. Morton. (Adam Hilger Ltd., London), 1942. Second Edition. Pp. 226. Price 28*sh*.

In a series of ten illuminating chapters, the author covers the entire field of vitamins, hormones, proteins, enzymes and co-enzymes in a broad and interesting manner suggestive of their inter-relationships. The first chapter gives a short account of the experimental assembly and the notations used in absorption spectrophotometry. References to literature where the technique of spectrophotometry is described at greater length, are given at the end of the chapter.

The second chapter is devoted to a consideration of the steroids including the closely allied antirachitic vitamins and sex hormones. Those interested in gaining an insight into absorption spectra in relation to chemical structure, will find this chapter exceedingly interesting and valuable. The subject of vitamins of the D group is treated against its historical background; reference is made to the difficulties encountered and to the precautions necessary in carrying out a spectrographic assay of vitamin D in natural products. The author has incorporated a substantial amount of his own experience in this field.

The third, the fourth and the fifth chapters respectively deal with (1) Provitamins and Vitamin A, (2) Vitamin E and Antioxidants, and (3) Vitamin K. They constitute a succinct and stimulating review of the vitamins of the fat-soluble group; the part played by spectroscopy in the discovery and development of these vitamins is indicated. The discovery of vitamin A_2 is directly the outcome of spectrographic methods of analysis. Those interested in the assay of the carotenoids and vitamin A should carefully study the relevant portions of the third chapter wherein attention has been drawn to the wide variability in the biological utilisation of β-carotene. The author adds: "When the chemist analyses a given product for vitamin A or provitamin A, he aims at a precise determination of the actual amounts present, whereas the biochemist's animal assay is concerned with available vitamin A or carotene. If a large proportion of the total is nutritionally useless, as often happens, it may be necessary to change the method of preparing or cooking the food, or to alter the bulk composition of the diet so as to improve utilisation. In short, the problem of vitamin A nutrition has emerged from a phase of spurious clarity, resulting from over-simplification, into a very complex phase in which the main task is the twofold one of refining both analytical methods and biological methods without confusing the many variables or failing to stress the distinction between vitamins and provitamins A."

Methods for the assay of butter with respect to its carotene and vitamin A contents, details for the assay of blood-serum for its content of vitamin A and carotenoids, and for the determination of carotene in dried grass and similar products, are described in the third chapter.

The water-soluble vitamins C and P and the B complex are treated in the sixth and the seventh chapters. The closely related and physiologically important group of purine and pyrimidine derivatives are dealt with in the eighth chapter. These compounds represent the products of degradation of some of the vitamines, nucleic acids, viruses and coenzymes. As the author remarks, "Spectrophotometric studies on purines are relevant to the study of coenzymes and the data on the pyrimidines to the problem of the structure of aneurin".

A discussion of the position of the absorption spectra of proteins in general, forms the subject of the ninth chapter; excepting for the fact that a spectrographic method for the detection and estimation of tyrosine and tryptophane has been developed, spectroscopy has contributed little to elucidation of the complexity of this class of compounds.

The discussion of purines, pyrimidines and proteins is appropriately and logically followed by the last chapter which gives a clear account of the apo- and co-enzymes of the oxidation-reduction group. Spectroscopy has played a fundamental rôle in the study of these systems; in fact, the only accurate and specific method for determining the activity of many of the coenzyme linked enzymes is the one provided by the spectrograph.

The author has rendered a great service to the science of spectroscopy as applied to the study and elucidation of problems of biochemical interest. The world-renowned and the progressive firm of Adam Hilger has sponsored the publication of this volume.

Annual Review of Biochemistry, Vol. XII. By James Murray Luck and James H. C. Smith. (Annual Reviews, Inc., Stanford University P.O., California), 1943. Pp. ix + 704 Price $5.00.

The impression created by a cursory glance of the Annual Review for 1943, is one of satisfaction that the progress of biochemical science has not been appreciably affected by the unhappy and emergent conditions imposed on scientific research by the global war; the volume of work as reviewed in the volume appears to be substantial in spite of the fact that much of the work conducted in the central and occupied Europe and in Japan has not generally been available to the reviewers.

The volume consists of twenty-four reviews and covers as usual, the fields of biological oxidations and reductions, enzymes, harmones, vitamins and viruses, metabolism of carbohydrates, fats, proteins, amino acids, minerals and sulphur compounds, the chemistry of steroids, lipins, carbohydrates, proteins and amino acids. Other topics reviewed include animal pigments, synthetic drugs, photosynthesis, carbon-dioxide assimilation by heterotropic organisms, electron microscope in biology and micro-chemistry.

The fat-soluble vitamins has been reviewed by Hickman who is one of the pioneers in the application of the principles of molecular distillation to the isolation and production of integrally pure vitamins and vitamin concentrates. He refers to some of the spectacular achievements in this field, still in the course of publication. The occurrence of what the author calls a post-vitamin (kitol) in whale oil, which on simple distillation gives rise to vitamin A, has been announced. This pyrolytic conversion of kitol into vitamin A represents the first instance of the *in vitro* transformation of a pro-vitamin into a vitamin. The next few years will no doubt witness a rapid development not only in the chemistry and biogenesis of this interesting product but also in the commercial production of vitamin A from this source.

The assimilation of carbon-dioxide by heterotropic organisms has formed the subject-matter of several reviews during the last two years. Another review on the same subject by one of the foremost workers in the field deals with the phenomenon as revealed by micro-organisms and serves to elucidate the mechanism and significance of carbon-dioxide assimilation. Attention should be specially invited to the thought-provoking review on the water-soluble vitamins by Roger J. Williams, who has discussed and critically appraised such of those pieces of work "which contribute new and crucial information regarding the chemistry or biochemistry of vitamins" and "which are most stimulative of further research along these lines". The relation of the vitamins of the B-complex to general metabolism, to embryonic development, to chemo-therapy, to harmonal control and to some of the diseases like pernicious anæmia and cancer. Particularly interesting is the suggestion that the B-vitamins influence the mental and psychological qualities in man. Reference is made to the unsatisfactory state of the chemistry of pyridoxin and evidence has been adduced to the occurrence of a pseudopyridoxin which, towards certain organisms, is a thousand times more active.

There is a review on the Electron microscope in Biology by L. Marton, a subject which is coming into practical prominence in recent years. With the aid of this new and powerful tool, deeper insight has been gained into the morphology of micro-organisms, the architecture of viruses and the adsorption phenomena.

The chemistry of viruses is discussed by Hoagland, with special reference to the animal viruses which have not been obtained in a state of the same degree of purity which characterises plant viruses. The author sounds a note of warning that "as a consequence of the great advance which has been made in an understanding of the properties of plant viruses, there has been * * * a too hasty extension of ideas gained from these studies to the formation of over simplified concepts of viruses in general, and animal viruses in particular".

In the preceding paras, reference has been made only to a few of the more important high-lights of biochemical research reviewed in the volume. Biochemical investigators throughout the world are familiar with these publications and will continue to eagerly look forward to its annual appearance.

FOREST TREE SEED*

SEEDS are verily the stuff on which life is sustained. Man's use of food of grain, millets and pulses, is merely incidental in the complex pattern wherein Nature, to ensure the perpetuation of the species thoughtfully provides bountiful harvests of seeds. No wonder, therefore, that man's interest in seeds is primeval. But, such interest has by no means been confined to the merely utilitarian plane. The scientific interest of seeds is compelling. For, seeds, as one authority graphically puts it, represent concentrated life. Neither 'living' nor 'dead' as these words are understood in common parlance, seeds are in a state of suspended animation. Some can remain so for hundreds of years. And, who amongst us has not pondered and been awed and humbled at the thought of a tiny seed growing up to a giant of a tree in the forest? If only trees could speak and tell their tales! No wonder that the poet and the philosopher have succumbed to the beauty and the mystery of seed, as in this delicious ditty:

> In the heart of a seed
> Buried deep, so deep,
> A dear little plant
> Lay fast asleep
> 'Wake' said the sunshine,
> 'And creep to the light';
> 'Wake' said the voice
> of the raindrops bright
> The little plant heard,
> And it rose to see
> What the wonderful
> Outside world might be!

Or again as evidenced by Shelley's immortal lines:

> "Oh thou
> Who chariotest to their dark wintry bed
> The winged seeds, where they lie cold and low
> Each like a corpse within its grave, until
> Thine azure sister of the spring shall blow
> Her clarion o'er the dreaming earth ..."

The latter lines appropriately form part of the preface of a fascinating volume on "Forest Tree Seed", recently published in the United States. Here, within the compass of twenty chapters, is a sufficient and well-arranged summary of the most significant research work in recent years on Forest Tree Seed.

When one ponders over the importance of seed to forestry practice, it is surprising that there should be such paucity of literature in the form of books. The classics on the subject in German are now largely out of date. The more recent text-books on Sylviculture are not (they are not intended to be) comprehensive on the subject of forest tree seed. At the same time, a large amount of data, of use to the Forester and value to the investigator, have appeared—scattered in a number of journals, some of them obscure or not readily available. "Such defects", says Dr. Baldwin, in his preface, "in our methods of disseminating the results of scientific study must be remedied by an occasional synthesis and digestion of the scattered information, and concentration in a single publication." "Forest Tree Seed" is the result.

The author has specialised in this subject for a number of years having had first-hand knowledge of it in America and in the leading forestry centres in Europe. He has devoted no less than fifteen years in garnering the material for this book and during this time he has had the good fortune of the co-operation of "a large number of persons who have co-operated in the preparation of this short volume. The number probably exceeds 100"; this list includes some of the most famous names in the Forestry and Plant Research world of America. Above all is the author's infectious enthusiasm of the devotee to his subject and it is, therefore, no wonder that Dr. Baldwin has produced a volume which bids fair to be the standard book on the subject for a long time to come. And as is to be expected of any Chronica Botanica publication, the get-up of the book is excellent—even sumptuous for a war-time publication.

The volume maintains an even balance between the "purely scientific" and the "practical and applied" aspects of the subject. The anatomy, chemistry and physiology of the seed are dealt with adequately while seed collection, extraction, storage and the biotic enemies of seeds are studied in greater detail, with special reference to North American forest stands. Chapters 8 to 13 on the chemistry of seed germination offer a rich storehouse to the research worker while the following five chapters deal with the purity, determination of origin, viability and germination of seeds—subjects of great importance to the practising forester. Seed testing stations form the subject of Chapter 18 while the penultimate chapter, 19, is short but suggestive on the design and conduct of seed research projects. In this chapter, the author approvingly quotes Donald Peattie: "If there is any living thing which might explain to us the mystery beyond this life, it should be seeds." That about neatly epitomises the spirit of eager enquiry which permeates the entire volume.

One of the most valuable features of the book is the bibliography, extending in all to about a thousand references appended at the end, to each chapter. "References have, as a rule, been listed only at the end of the first chapter in which they occur" (p. 10). This is not conducive to ready reference at later stages in the book when the reader is compelled for tracing the original paper of a citation, to first refer to the name index, find out which the first citation in the book to this particular author is and then back-refer to this chapter for getting at the original paper. Such needless annoyance could easily be avoided by simply listing *all* references at the end of each chapter. Any repetition would be occasional and not materially add to the bulk of the book. An Author Index and an

* **Forest Tree Seed** *of the North Temperate Regions, with special reference to North America* by Henry Ives Baldwin (Chronica Botanica Ltd., Waltham, Mass., Calcutta: Messrs. Macmillan & Co. Ltd.), 1942, Pp. 16 + 240, Price 4·75 dollars.

Index of Plant and Animal Names make for ready reference while a Glossary of tree seed terms with their French, German, Danish, Norwegian and Swedish equivalents is welcome to the research student who has to consult literature emanating from the continental research stations.

One could wish that State Legislation relating to forest seed and trade in the progressive countries had been dealt with in slightly greater detail than in Chapter XVIII for such legislation has proved to be the bed-rock on which the improvement of Forest Stands in some continental countries has been attempted. Also, the statement on p. 214, "Artificial sowing of tree seeds is at best a poor imitation of Nature's way of producing forests", would appear to many foresters as much too sweeping a generalisation. The fine, extensive, even aged crops in the central European forests and of our own successful teak plantations are examples of what "Artificial sowing" can achieve.

Dr. Baldwin's "Forest Tree Seed" is an unusually well-written and comprehensive volume which is indispensable to the research worker and of great use to the professional forester—yes, even to the forester in India although the book is avowedly written "with special reference to North America". In fact, less than about half a dozen author references relate to work done in India. But the general principles relating to seed collection, cleaning, storage and germination are by no means merely local in application. This book should be specially useful to the Indian forester in its revelation of the large amount of work of practical value being done elsewhere on forest tree seed and in its suggestiveness in planning research for Indian species and under Indian conditions.

Such planned work on forest tree seed is urgently called for in India. It is only comparatively recently that, even in the case of the more important species, empirical nursery methods have been subjected to rigorous scientific investigation. Empirical methods may be good. But, they are not enough. Even the very concepts of tree races have undergone profound changes as a result of recent work. Thus, Dr. Baldwin quotes Münch who "goes so far as to say that races have nothing to do with morphological differences, which may be superimposed upon fundamental physiological adaptations" and that "Pine in different places of its range belongs to the same species only in external appearance" (p. 29). Such revolutionary advances in our knowledge of forest trees must be taken note of and translated into current Indian practices. It is more than likely that in the post-war world, the importance of wood as the raw material of industry will transcend the utility of wood as a mere material of construction and that our prevalent notions of the relative values, commercially speaking, of Indian timbers will be profoundly altered. Comparatively limited as India's resources in coal and iron ores are, it is not unlikely that the future expansion of Indian industry will witness an increasing prominence of cellulose as raw material—a material which her climatic conditions enable her to produce abundantly and cheaply. So great indeed are the basic advantages which India enjoys in this respect that it is freely predicted that the Indian industries of tomorrow will be *cellulose* industries. And, for this purpose, the accepted technique is the production of forest crops of *short* rotation in compact plantations. The raising of such plantations as feeders of raw material to Indian industry compels the adoption of the most scientific practices in relation to forest tree seed in India.

There is one other and very important reason as to why the publication of Dr. Baldwin's book just now is particularly welcome. The vital needs of war have compelled the production and use of enormous quantities of timber; and, in some cases at least, the limits to such production have been factors other than what is accepted to be sylviculturally sound for the particular forest stand. It is, therefore, obvious that large-scale reafforestation programmes have to be undertaken in the years immediately following the war to restore and improve forest stands. As a matter of fact, such reafforestation programmes form a prominent feature of the post-war reconstruction plans of several countries. To take but one example, the Report on Post-War Forest Policy, just published, of the Forestry Commission of Great Britain, envisages five million acres of woodlands as the aim for Great Britain. Similar plans and specific programmes are being drawn by authoritative agencies in other countries. Here in India will also be presented to foresters a great opportunity. Here and now is the time to take stock of Indian needs and prepare programmes for Indian conditions. The provision of adequate quantities of tested seed of suitable strain should be an integral part of any such programme.

'As you sow, shall you reap.' Forestry has special reasons to be mindful of this ancient adage. For, forest crops are generally harvested long after they are born and effects traceable to seed may not be felt or even become apparent for several decades. At that stage of the crop, corrective measures are usually limited to sylvicultural operations which, even if not ruled out on other considerations, are apt to be costly. The forester pays and pays dearly for his sins of omission and commission in his choice of seeds. It is but common prudence that he should not commit such errors which, with a little knowledge, are easily avoided and at the same time adopt practices which are proved to be sound. For this, he could, to start with, do no better than delve into the mine of information contained in "Forest Tree Seed".

SCIENCE NOTES AND NEWS

Post-War Organisation of Scientific Research in India.—We wish to invite the attention of our readers to the highly thoughtful and informative inaugural address delivered by Sir J. C. Ghosh, Director, Indian Institute of Science, before the National Institute of Sciences on the occasion of the Symposium on Post-War Organisation of Scientific Research. The address appears in the October 1943 number of *Science and Culture*.

Co-ordination of Agriculture and Industry.—Inaugurating a new Industrial Enterprise for the Production of Heavy Chemicals in the State, Sir C. P. Ramaswami Aiyar, Dewan of Travancore, declared: "It is the policy of His Highness' Government—a policy it is my duty and privilege to promote to the maximum extent possible—that this State should repair the past neglect of industrial development throughout India as a whole and this State in particular and take advantage of our abundant natural resources and intelligence of the people so as to bring about that co-ordination between agriculture, industry and manufacture, without which national prosperity would not be achieved. I am deliberately mentioning three things, namely, agriculture, industry and commerce, because in conditions of India today, and *a fortiori* in the conditions of Travancore to-day, the welding of these three activities is a problem of utmost urgency."

"Travancore", he added, "does not wish to continue for ever to go about with beggar's bowl, though her present needs are greater intrinsically than those of the localities which are so much in evidence to-day and which, while producing eighty centum of their foodstuffs, go on asking for more and more food. Much needed provisions are not unfortunately made available to the people at large who cannot make their voices heard. This maldistribution is most prejudicial to the legitimate claims of localities which produce only forty centum of their requirements and had been relying in the past on imports for their bare subsistence and grew commercial crops needed by the world at large. We have to impress on the world that enterprises like the present are not luxuries at this juncture and the Central Government should give them all necessary facilities by way of priorities, etc. Unless we extend and intensify our cultivation, we shall continue to suffer and are too far away for our troubles to be rightly appreciated and remedied."

Production of Fertilisers.—A conference of the representatives of chemical industry and of the Supply, Food and Commerce Departments, was held in New Delhi to consider methods of increasing the production of fertilisers, particularly of ammonium sulphate. The Session was presided over by Sir A. Ramaswami Mudaliar and the deliberations lasted for two consecutive days (September 29 and 30, 1943).

The consumption of ammonium sulphate in India, which went up steadily in the pre-war years to 96,000 tons per annum, has fallen since 1939-40, mainly due to restrictions of imports resulting from the war. The need for increasing production from indigenous sources, both on a short-term basis and from the point of view of long-term possibilities, was emphasised at the first day's session.

A committee, with Sir P. M. Kharegat, Vice-Chairman of the Imperial Council of Agricultural Research, as President, and Messrs. Kapilram Vakil, Gilmour, Shankarlal, Davies, Parker, Krishnaswami, Modi and representatives of the Government, was formed.

The Conference resumed its session on the following day; several representatives of industry expressed their readiness to put up plants, subject to assistance which the Government could render. The Conference considered the report of the Sub-Committee appointed on the 29th, which examined the possibilities of new production within the next two years, the most easily available resources which could be exploited and the assistance that would promote the proposed expansion of the industry.

The Committee estimated the existing capacity for production of ammonium sulphate at about 30,000 tons against the Food-Grains Policy Committee estimate of 350,000 tons a year required as fertilisers if India's dependence on imports of rice was to be reduced. A total production of 350,000 tons from the new plants proposed to be started within the next two years was considered feasible.

The most urgent problem consisted in the importation of the necessary plants and the difficulties imposed by the war conditions. The Government will, however, actively pursue the question of importing plants as the first step in the scheme of expansion.

Jute Position in 1942-43.—Reviewing the jute position in 1942-43, the September issue of the Indian Central Jute Committee *Bulletin* states that (1) difficulties of shipping, (2) regulation of jute crop in Bengal, and (3) difficulties of internal transport were the chief events which affected the jute position during the period.

The first restricted the effective demand for jute; the second was an attempt to adjust supply to demand; while the third tended to upset the balance that was expected as a result of the former two. The net position was that there was no marked improvement or deterioration in the jute trade as a whole.

Cotton and paper for manufacture of bags to substitute burlap not being available in anything like the volume required, the shortage of bag supply continued in the U.S.A.

Recent news received from South America indicates that there is still no material change

in the bag supply situation in the Argentine, where shortage continues.

In Brazil the co-ordinator of Economic Mobilisation has authorised the creation of a special body to control the production and distribution of various national fibres, as well as the manufacture and sale of their products. Amongst other things, the new body is empowered to take steps to increase the proportion of national fibres used by local manufacturing concerns. The Brazilian Government has approved a plan for the encouragement of the cultivation of flax, and official steps to increase the output of "Ramie" fibre are also to be taken.

Grow More Rice.—One of India's most urgent needs to-day is the production of more rice. Thus it is gratifying to find that amongst the 39 sections which have been incorporated in the forthcoming 'Art in Industry' Exhibition which is to take place in Calcutta early in 1944, there is one section devoted to 'Grow More Rice' propaganda. Artists are asked to send in designs for posters and it is hoped that this will be one of the most popular sections in the Exhibition, because, apart from the inducement of big prize money to artists, it is linked up with the nation's most vital interest.

National Research Council.—The Council of the National Institute of Sciences of India was authorised to take necessary steps for the organisation of a National Research Council constituted under the statutory authority of the Government of India, at the symposium on Post-War Organisation of Scientific Research, held this month in Calcutta. It was also decided to approach the Government of India for an annual grant of five crores of rupees to enable the Council to give effect to its policy of scientific development.

The symposium considered that the National Research Council should be directly responsible to the Government. Its main functions should be to plan the main lines of scientific work in accordance with national needs, to ensure balanced development of all branches of science and advise and help regarding training and supply of scientific personnel for pure and applied research. The Council should consist of scientific and technical experts not exceeding sixty in number, the majority of whom should be elected by non-official scientific organisations, including universities. Boards of research should be constituted for each sphere of work, and each board should be authorised to constitute research committees on all important subjects.

Sir Dorabji Tata Trust.—Donations to the extent of over 60 lakhs of rupees have so far been made by the Sir Dorabji Tata Trust, which has now completed its ten years of service in the cause of education and humanity. They cover a wide range of charitable objects in every part of India, and in a few cases in response to appeals from overseas.

The largest single project undertaken by the Trust has been the establishment and maintenance of the Tata Memorial Hospital for Cancer; this was brought into existence in 1940 at a capital cost of Rs. 23 lakhs and is maintained at an annual expenditure of Rs. 4 lakhs. The Tata Graduate School of Social Work, which trains young men and women from the universities in social work, is the first institution of its kind in India and has already proved to be of great service. The School is maintained at an annual cost of over Rs. 50,000.

Scientific and technical education has received particular attention from the Trust. Nearly 300 men and women have received assistance for prosecuting their studies at home and abroad. In pursuance of this commendable policy, the Trust, jointly with the Tata Iron and Steel Co., have recently donated Rs. 8,30,000 towards the establishment of a National Chemical Laboratory at Poona. The Calcutta University was also financed to instal a Cyclotron at a cost of Rs. 60,000.

Besides, the Trust have donated over Rs. 5 lakhs for the relief of sufferers in the Bihar and Quetta earthquakes, the Midnapore Cyclone and the present Bengal famine.

We wish to tender our grateful appreciation of the munificence which has always characterised the great and illustrious family of the Tatas.

Wood and War.—Addressing the fifty-first annual meeting of the International Concatenated Order of Hoo Hoo in Milwaukee, Wis., on September 10, 1942, Dr. Carlile P. Winslow, Director, Forest Products Laboratory, Madison, Wis., declared, "In the popular mind this is a war of dive bombers and high-speed armoured divisions—yet to make this war of machines function requires a larger quantity and variety of forest products than has been used in any previous war. As a matter of fact, this has been recognized by the Germans for a long time. Three years ago this month, before leaving Germany, I learned that Goering had put wood second on his list of essential materials—second only to steel.

The list of wood items demanded by war's insatiable appetite goes on and on—wood for hangers, scaffolding, boats, wharves, bridges, pontoons, railway ties, telephone poles, mine props, anti-tank barriers, shoring, shipping containers, and air-raid shelters; plywood for airplanes, black-out shutters, prefabricated housing, concrete forms, ship patterns, assault boats, ship interiors, truck bodies and army lockers; fuel for gasogense, for trucks and tractors; pulp and paper for surgical dressings, boxes, cartridge wrappers, building papers, pasteboards, gas-mask filters, printing, and propaganda distribution; synthetic wood fibres, such as in rayon, artificial wool and cotton, for clothing, parachutes and other textiles; wood cellulose for explosives, wood charcoal for gas-masks and steel production; rosin for shrapnel and varnishes, turpentine for flame throwers, paint and varnishes; cellulose acetate for photographic film, shatterproof glass, airplane

dopes, lacquer, cement and moulded articles; wood floor for dynamite; wood bark for insulation, tannin, and dyestuffs; and alcohol from wood for rubber. Only recently the Government has ordered that all Army truck bodies shall be built of wood to conserve steel—a use that is currently requiring approximately a million feet of hardwood a day.

The amount of lumber used for containers is almost unbelievable. The number of boxes required for the shipment of ammunition alone runs into thousands per day. It is estimated that more than 7 billion—not million—board feet of lumber will be required for containers in 1942 and a substantially greater amount in 1943.

All told our lumber needs this year (according to the War Production Board) will exceed 39 billion board feet. Actually we are estimated to be cutting only 33 billion feet. A stock pile of some 5 billion feet in the hands of manufacturers is rapidly vanishing in the face of this gap between production and consumption.

MAGNETIC NOTES

Magnetic conditions during September 1943 were slightly less disturbed than in the previous month. There were 5 *quiet* days, 21 days of *slight* disturbance and 4 days of *moderate* disturbance as against 13 quiet days, 16 days of slight disturbance and one of moderate disturbance during the same month last year.

The quietest day during September 1943 was the 24th and the day of the largest disturbance was the 29th.

The individual days during the month are classified as shown below:—

Quiet days	Disturbed days	
	Slight	Moderate
6, 7, 18, 20, 24.	1–5, 8–17, 19, 21–23, 26, 27.	25, 28–30.

No magnetic storm occurred during the month of September in the years 1942 and 1943.

The mean character figure for the month of September 1943 was 0·97 as against 0·60 for September last year.

M. V. SIVARAMAKRISHNAN.

Medical History Exhibition.—Dr. D. V. S. Reddy, Andhra Medical College, Vizag, writes to us as follows:—

Medical men who have attended the meetings of the British Medical Association or even read *Proceedings* of the above meetings in Oxford, Cambridge, London or Australia, may remember how interesting and instructive medical history exhibitions can be.

As early as in 1936, I published a plea (see my letter in *British Medical Journal*, dated 21st November 1936) requesting that the rare and instructive Indian medical manuscripts in Oxford, Cambridge and London may also be exhibited along with the British, European and Arabian exhibits, at the time of the meetings of the British Medical Association. Professor Charles Singer of London, who communicated my letter to *B. M. J.*, stated that he and the Editor of the *B. M. J.* fully endorsed my plea.

I have also made a plea for similar medical history exhibitions in India in a paper read before the Medical Section of the Indian Science Congress held at Calcutta in January 1938 and that paper, "A plea for the promotion for the study of history of medicine", has been printed in the *Journal of the Indian Medical Association*, September issue, 1938.

At the Madras Session of the Science Congress in 1940 in my paper, "The present position of the history of medicine in India" (*J. Ind. Med. Assn.*, May 1940), I made the following appeal: "Another matter which has been sadly neglected and which deserves the attention of all organisers of conferences and congresses is the value and inspiration of an exhibition of old books, manuscripts and printed ones, illustrating the progress of medicine in space and time. ... Indian cities where medical conferences are held are rich in materials for such exhibition and with the co-operation of the University Library, Oriental Libraries or private learned bodies, it should not be difficult to organise a fairly representative exhibition of rare and old manuscripts of early printed editions of portraits and paintings pertaining to medicine and of medical relics and curiosities." In the ensuing discussion, some leading members of the medical section and professors of the Medical Colleges at Madras asked me if I could not arrange for such an exhibition for the next day. I pointed out that I would be able to do so if the local Secretaries of the Reception Committee could persuade the authorities of the Medical College Library and the University Library and the Oriental Library to lend certain of the exhibits.

Now that the Indian Science Congress is holding its session in a State famous for the promotion of Oriental studies and publications, as well as for the collection of art treasures and archæological relics, I would appeal, in my individual capacity as a student of History of Medicine and in a representative capacity as the corresponding member of the American Association of the History of Medicine, to the organisers and Reception Committee of the Science Congress in Trivandrum, to take the initiative and have, side by side with the usual industrial or commercial or scientific exhibition, a cultural and medico-historical exhibition of the type till now arranged only in America and Europe.

LIST OF EXHIBITS TO BE COLLECTED AND INCLUDED

I. Gods of Healing.—(*a*) Idols, (*b*) Dolls, (*c*) Plaques, (*d*) Stone panels, (*e*) Images, (*f*) Pen and ink sketches, (*g*) Paintings on paper or glass, (*h*) Reproduction of wall paintings, (*i*) Photos of temples or of idols of gods worshipped in the State for special diseases, (*j*) Votive offerings.

II. Medicine in Art.—(*a*) Stones, sculptures or panels or paintings or outline drawings illustrating incidents from Indian legends or epics showing the wounded or the sick or treatment of the sick.

III. Medical Manuscripts.—(*a*) Ancient and mediæval Sanskrit medical classics; (*b*) Manuscripts in South Indian languages; (*c*) Manuscripts in European languages (Portuguese or English records dealing with medicines or diseases or physicians).

IV. Early Printed Books in Medicine.—(*a*) Books in European languages (Portuguese and English, etc.); (*b*) Books in South Indian languages, (*c*) Books in Sanskrit.

V. Relics of Medical Interest.—(*a*) Flints, bones, knives, lancets, forceps, splints; (*b*) Containers of medicine mortars, etc.

VI. Records of Heriditary Physicians.—(*a*) Family genealogy with sketches or notes on physicians and note books on medicine kept by families; (*b*) Records of 17th and 18th century missionaries dealing with medical relief; (*c*) Records, sketches and descriptions of the early Portuguese, English or other hospitals in the State and surrounding areas.

VII. Description of epidemics or special diseases from State records or private records.

VIII. Medical Lore in Literature.—(*a*) Any Malayalam classics, describing doctors or their work with a short abstract in English; (*b*) Books dealing with merits and virtues of sacred places and mineral springs.

IX. Medicine in Folklore.—(*a*) Sayings or songs; (*b*) Armlets and charms.

X. Books on the History of Medicine.—(*a*) Books dealing with history of medicine in general; (*b*) Books dealing with special branches of medicines; (*c*) Books dealing with history of medicine in India; (*d*) What other countries are doing for the promotion of the studies in history of medicine.

The All-India Manufacturers' Organization.—At a meeting of prominent businessmen, financiers and industrialists held recently at Nagpur and addressed by Mr. Sankalchand G. Shah, Vice-President of the A.-I.M.O., the C.P. and Berar Provincial Board of the Organization was started in order to carry out the programme of industrialization in the Province.

The following office-bearers were elected:—Sir Madhavlal Despande (*President*), Shrimant M. G. Chitnavis (*Vice-President*), Seth S. R. Surana (*Vice-President*), and Mr. D. W. Mandpe (*Secretary*).

We acknowledge with thanks the receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 91, Nos. 4642, 4643 and 4645.

"Journal of Agricultural Research," Vol. 66, Nos. 10-12.

"Agricultural Gazette of New South Wales," Vol. 54, Pt. 8.

"Allahabad Farmer," Vol. 17, No. 4.

"Calcutta Review," Vol. 89, No. 1.

"Journal of the Indian Chemical Society," Vol. 20, Nos. 8 and 9.

"Journal of Chemical Physics," Vol. 11, Nos. 6-7.

"Chemical Products and Chemical News," Vol. 6, Nos. 7-8.

"Experiment Station Record," Vol. 89, No. 1.

"Transactions of the Faraday Society," Vol. 39, Pts. 7 and 8.

"Indian Forester," Vol. 69, No. 10.

"Indian Medical Gazette," Vol. 78, No. 9.

"Review of Applied Mycology," Vol. 22, Nos. 6-7.

"Bulletin of the American Meteorological Society, Vol. 24, Nos. 2 and 3.

"Journal of Nutrition," Vol. 26, No. 1.

"Nature," Vol. 152, Nos. 3844-45, 3849-50.

"Journal of the Bombay Natural History Society," Vol. 44, No. 1.

"Indian Journal of Physics," Vol. 17, Pt. 3.

"Science," Vol. 97, Nos. 2524-27; Vol. 98, Nos. 2530-32, 34-36.

"Science and Culture," Vol. 9, No. 4.

"Monthly Science News," Nos. 23 and 24.

"Sky," Vol. 2, Nos. 8-10.

"Indian Trade Journal," Vol. 150, Nos. 1943-1946.

BOOKS

The Carnivorous Plants. By Francis Ernest Lloyd. (Messrs. Chronica Botanica Co., Waltham, Mass. Calcutta: Messrs. Macmillan & Co., Ltd.), 1942. Pp. 352. Price $6.

Annual Review of Biochemistry, Vol. 12. By James Murray Luck. (Annual Reviews Inc., California), 1943. Pp. 704. Price $5.

Annual Review of Physiology, Vol. V. By James Murray Luck. (American Physiological Society and Annual Reviews Inc., Calif.), 1943. Pp. 613. Price $5.

Indian Village Health. By J. N. Norman Walker. (Oxford University Press, Madras), 1943. Pp. 99. Price Rs. 2-8-0.

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CURRENT SCIENCE

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ASTRONOMICAL RESEARCH IN INDIA: II

IN *Current Science* for July 1943, a plea was entered for the promotion of astronomical study and research of the highest grade in our country. We require, in the first place, the establishment of observatories in different parts of India staffed by competent and enthusiastic astronomers and equipped with instruments capable of yielding results of real interest and importance. From Kashmir in the north to Trivandrum in the south, from Shillong in the east to Karachi in the west, the territories of the Indian Empire include a variety of latitudes, elevations, climates and observing conditions. A selection could be made of possible locations for a group of observatories which between them could cover the heavens in systematic programmes of exploration and study, all the year round. Then again, the Universities in India should take steps to give astronomical studies and research a proper place in their activities, instead of relegating them, as at present, to an unimportant and practically negligible status.* Astronomy can have no future in India, unless opportunities are given to talented young men to interest themselves in the subject at the Universities. It is necessary also to take steps to encourage and develop public interest in astronomy. Every city of any importance in India should maintain at public expense an observatory of reasonable dimensions which would be open to the public free of charge. Such an institution would be a cultural centre where even the humblest individual who desires to do so could acquaint himself at first hand with the facts of astronomy. There should also be societies and groups of amateur astronomers in every province to maintain and develop an active interest in the progress of astronomical science, by regular meetings, discussions and public lectures.

* The Osmania University at Hyderabad is an honourable exception in this respect.—C. V. R.

The programme outlined above presupposes many things—an enthusiasm for astronomy, a willingness to work for its progress, the desire and ability to find the money needed for its active promotion, and above all an atmosphere in which the pursuit of the science could flourish and not be regarded as a useless luxury. It might be urged that a poor country in which the vast majority of the people live at or below the marginal level of human existence, should not trouble itself about astronomy—a non-utilitarian pursuit, as some might be disposed to regard it. To convert those who hold this view to a different state of mind, it might be useful to point out clearly the enormously important part that astronomical studies have played and are playing in the development of both scientific knowledge and general culture. That astronomy occupies the premier position amongst the sciences will be evident if we recall its organic relationships with the other sciences. The basic idea of all science is the concept of law in Nature—the view which regards natural phenomena as an ordered sequence of events linked together by a chain of causation. This concept is an intellectual conviction which established itself in the first instance from the observational facts of astronomy, including especially the most familiar of them all, such as the daily rising and setting of the sun and the moon, the variation of the seasons, the predictability of eclipses and the like. The fundamental ideas which lie at the basis of all the sciences, *viz.*, the notions of time and space, matter and gravitation, light and darkness, heat and cold, all come to us as part of the astronomical environment in which we live. The deeper we delve into the various branches of natural knowledge, the more clearly do we perceive that everything on this earth and inside it, both in the remote past and in the immediate present, has been determined by the astronomical history of our planet. The

structure and functions of every living object on the face of the earth and the rhythm of its daily life bear the imprint of our astronomical environment and history in language which can be read very plainly.

The pursuit of astronomical studies in any country has an enormously stimulating influence on other branches of scientific investigation. Consider, for instance, that most abstract of all sciences, mathematics. A long roll of illustrious names in the history of science could be cited to indicate how the facts of astronomy and the attempt to interpret them furnish the motive power for the development of new kinds of mathematical thought. Just to mention, Archimedes, Bhaskaracharya, Kepler and Newton should be a sufficient lesson to us from the history of the past. The contents of Newton's immortal work, the *Principia* opened up a new world of thought alike in the regions of mathematics, astronomy and physics. Laplace and Einstein may be mentioned amongst the intellectual giants to whom the facts of astronomy were at once a challenge and an inspiration to develop new ways of mathematical thinking. An astronomical theorist has, of necessity, to be a first-rate mathematician, but his work benefits not only astronomy but all fields of science in which analogous methods could be applied. A striking illustration of this is the recent work of Chandrasekhar on the dynamical theory of stellar systems. As a published report by him reveals, the mathematical developments he has initiated are applicable also in the realms of molecular physics and of colloid chemistry!

As every physicist knows, the study of the stars and the study of the atoms are only two different phases of the attack on the fundamental problems of his subject. In the July article, mention was made of the discovery of the finite velocity of light by Romer, of aberration by Bradley, of laws of planetary motion by Kepler, of the dark lines in stellar spectra by Fraunhofer, of helium in the sun by Lockyer, of the magnetic field in sunspots by Hale, and of the recession of the nebulæ by Hubble. These are typical examples of what might be called the purely observational discoveries of astronomy, which have exercised a profound influence on the orientation of physical thought. Such a list could be extended almost indefinitely. We may put the situation briefly by saying that the Universe is a physico-chemical laboratory of cosmic dimensions and that we are privileged to watch through our giant telescopes a never-ending succession of experiments made on a scale and under conditions which we could never hope to reproduce with our comparatively Lilliputian resources. What we see has much to teach us. It forces us to think deeply. With minds strengthened and refreshed by new ideas, we look again through the telescopes and understand better what we see. But that is not all. The facts of astronomy suggest new modes of attack on the problems of experimental and theoretical physics. When, for example, Niels Bohr set out in 1913 to solve the problem of atomic structure, he found his inspiration in the work of Copernicus, Kepler and Newton. His astronomical model of the hydrogen atom with the electron going round the nucleus in an elliptic orbit as the earth goes round the sun was a magnificent success. As every student of physics and chemistry knows, it opened up great new vistas of physical and chemical thought. To-day, the physicists are watching the skies to discover, if possible, the origin of the mysterious cosmic rays which have meant so much to them in every possible way!

Chemistry is a subject of vast practical importance, and to the uninitiated, it might seem that it could have nothing in common with the science of astronomy which lives with its head up amongst the stars! It is useful to dispel such an illusion if it exists in the minds of any. The vital link between chemistry and astronomy is to be found in the problems of the origin of the elements, of their abundance, and of their associations and segregations, all of which are of the utmost importance not only to the chemist, but also to the geologist, the mining engineer and the metallurgist. The spectroscope reveals that all or nearly all the elements present in the earth are also present in the stars. Even the mysterious nebulium proved to be nothing more mysterious than oxygen and nitrogen under somewhat unfamiliar conditions. The problem of the origin of the elements is, therefore, not so much a terrestrial problem as an astronomical one. The transmutations of the chemical elements successfully effected, though on a very minute scale, in the atom-smashing laboratories of the world suggest that such or other analogous transmutations are in progress in the cosmic crucibles which we call the stars. Indeed, the suggestion has been made (and is probably well-founded) that such transmutations are the origin of the tremendous outpouring of energy continually going on from the sun and the stars. Such extra-terrestrial knowledge cannot but prove ultimately of the highest value and importance to terrestrially-minded capitalists and *entrepreneurs* of industry!

The tremendous interest aroused at the time by the observations of Lowell at the Flagstaff observatory on the planet Mars may be cited as an indication of the possible or probable relations between astronomy and the as-yet-unsolved problems of the origin and distribution of organised life. There can be little doubt that the history of life on the earth as illustrated in the record of the rocks was to a great extent determined by the astronomical history of our planet. There is striking evidence in the record of notable climatic changes and associated with them also of the disappearance of some of the older forms and the appearance of newer forms of life from age to age. It cannot be assumed that the evolution of life on the earth has come to an end. Far from this being the case, man is now keenly interested in the process and is taking an active part in the creation or development of new plants and even new animals, which could be of service to him. Can it be assumed that the radiations of various kinds received by the earth from space play no part in biological evolution? Probably not. Be this as it may, no geologist or biologist afford to ignore what astronomy can tell him about the past, present and future of the earth.

Let us leave science now and consider for

a moment the cultural aspects of astronomical study. Can it be denied that astronomy is the noblest and the grandest of the sciences, that it takes us away, if only for a while, from the noise and the dust of terrestrial conflicts and leads us to a better comprehension of the universe we live in and its eternal verities? Our politicians and philosophers are constantly reminding us of India's great spiritual heritage. Should they not raise their voice also to remind us of India's intellectual heritage as reflected in our age-old interest in astronomy, and help to build up a renewed and active interest in its study?

C. V. RAMAN.

POST-WAR ORGANISATION OF SCIENTIFIC RESEARCH IN INDIA

A SYMPOSIUM on Post-War Organisation of Scientific Research in India was held under the auspices of the National Institute of Sciences of India on the 27th and 28th September 1943, in the hall of the Royal Asiatic Society of Bengal, Calcutta.

As a result of the discussion the following tentative proposals regarding the formation of a National Research Council were adopted. It was decided further that these proposals be circulated to the Government Scientific Departments, Universities, learned societies and unattached institutions for expression of their views, and discussed, with a view to their being given effect to, at another symposium meeting to be held at Delhi towards the end of the year at which representatives of the relevant organisations would be invited to be present.

I. The Council of the National Institute of Sciences of India be authorised to take necessary steps for the organisation of a National Research Council constituted under the statutory authority of the Government of India. The National Research Council shall be directly responsible to the Government and have the following functions:—

(a) To plan the main lines of scientific work in accordance with national needs, to formulate schemes for the above purpose, to review and modify the same whenever necessary and to recommend ways and means for implementing the results of accomplished researches.

(b) To ensure balanced development of all branches of science, and minimise overlapping.

(c) To advise and help relevant authorities regarding the training and supply of scientific personnel for pure and applied research.

CONSTITUTION

National Research Council.—The National Research Council shall consist of scientific and technical experts not exceeding sixty in number, the majority of whom shall be elected by non-official scientific organisations, including Universities and institutions of University rank, the remaining number being nominated by the Government of India from among the scientific and technical experts. The President of the National Research Council shall be nominated by the Government of India from among the members. A Vice-President shall be elected by the National Research Council from among its members. A whole-time salaried Secretary shall be appointed by the National Research Council for carrying on its work, who will not be a member of the Council.

Governing Body of the National Research Council.—There shall be a Governing Body of the National Research Council which shall consist of the following: The President and Vice-President of the National Research Council, and the Chairman and Vice-Chairman of each of the Boards.

Boards of Research.—For the performance of its functions the National Research Council shall constitute the following Boards of Research from among its own members, each of which will be responsible, within its own particular sphere, for giving effect to the policy of the National Research Council:—

(1) Board of Scientific Research,
(2) Board of Agricultural Research (Soils, Crops and Animal Husbandry),
(3) Board of Medical and Public Health Research,
(4) Board of Engineering Research, and such other Boards as may be considered to be necessary.

The maximum number of members of each of the Boards of Research shall be fifty. The National Research Council shall appoint the Chairman and Vice-Chairman for each Board and shall co-opt eminent scientific workers in different branches in consultation with non-official scinetific organisations, Universities and institutions of University rank, scientific departments of the Government, and Federations of Chambers of Commerce.

Research Committees.—For the performance of its work, each Board will be authorised to constitute Research Committees for all important subjects, to settle the objectives of research, indicate the individuals or organisations which could undertake the several component parts of the enquiry, receive, and co-ordinate the resulting information, make it available to those who will turn it to advantage and to form a national plan into which all who are in a position to contribute information can fit the particular lines of research. Governing Bodies of National Research laboratories, when established, shall be constituted in consultation with the relevant Research Committees.

II. The Government of India be requested to form development corporations for the performance of functions analogous to those performed by the Research Enterprises Ltd., in Canada. The National Research Council shall be represented on the Governing Bodies of the development corporations.

III. To enable effect being given to the policy of scientific development determined by the National Research Council, the Government of India should make grant of five crores of rupees per annum.

COCONUT SHELLS AS AN INDUSTRIAL RAW MATERIAL

I. COMPOSITION OF SHELLS

BY DR. REGINALD CHILD
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THE object of these articles is not so much to report new observations (though the preliminary results of some unpublished work are included) as to review the properties of coconut shells and to examine their status as a potentially valuable raw material.

COMPOSITION

(*i*) *Moisture*.—The moisture content of shells varies considerably with conditions and with maturity. Under average conditions air-dried mature shells contain 6 to 9 per cent. of moisture[1,2] and thus retain less moisture than most woods. This is an important point in connection with dry distillation (see subsequent article). All analytical figures quoted in the following discussion are given as percentages of dry material, unless otherwise stated.

(*ii*) *Ash*.—Figures ranging from 0·23 to 1·425 per cent. have been recorded; recent references give values based on dry weight, but in the older citations it is not usually clear whether or not the results have been so corrected. The following is a selection of analytical figures from the literature:—

Authors	Reference	Date	% Ash	As percent. of ash: K_2O	Na_2O	CaO	MgO	Fe_2O_3 + Al_2O_3	P_2O_5	SO_3	SO_2
Fleck *et alii*.	1	1937	0·23	—	—	—	—	—	—	—	—
Bachofen	12	1899	0·29	45·01	15·42	6·26	1·32	1·39	4·64	5·75	4·64
Phillips and Goss	4	1940	0·55	—	—	—	—	—	—	—	—
Child and Ramanathan	2	1938	0·61	—	—	—	—	—	—	—	—
Georgi	5	1941	0·69	52·20	—	—	—	—	—	—	—
Norris (quoted by Sampson)	3	1923	1·10	31·6	—	2·97	3·87	—	5·32	—	—
Lépine (quoted by Copeland &c.)	13	(1861)	1·41	*	—	*	—	—	*	—	—
Fesca	16	1904	1·425	30·0†	—	2·32†	1·12†	—	5·00†	—	—

* 86·94 per cent. of "salts of K"; 2·18 per cent. of calcium phosphate; "salts of Ca" 6·53.

† Calculated from the figures given in Preuss (*loc. cit.*) as the percentages on the original shell, assuming an ash content of 1·425%.

shell charcoal is required by some specifications (see second article) to contain not above 2·0 per cent. by weight of the original shells; this implies a maximum of 0·67 per cent. ash on the latter and the writer has, in the course of examining many samples of charcoal, never found this limit exceeded with uncontaminated samples. Potash is clearly the principal constituent of the ash. The salts will largely be present as carbonates, but phosphate, sulphate and silicate also occur, as well as chloride. It is curious that chloride estimations have not been recorded; the writer's (unpublished) analyses of charcoal samples indicate the presence of 1 to 2 per cent. of Cl[1] in the ash.

About 90 per cent. of the ash is water-soluble, and the present writer[2] has also shown that most of the potash is extracted from the powdered shells by hot water.

The ash content is comparable with that of most woods; the large proportion of soluble ash is an advantage in the preparation of activated charcoal, since it is easily removed.

Georgi and Gunn Ley Teik[15] report the following average figures for eight lots of shells averaging 20·2 per cent. moisture (*i.e.*, not air-dried but as collected): K_2O 0·364, CaO 0·009, MgO 0·014, P_2O_5 0·035. They do not, however, state the actual ash contents, so that their figures cannot be collated with the above table; from inspection of the figures it looks as though the ash content would have been considerably higher than 0·6 per cent.

Doubtless the percentage and composition of the ash vary with soil and climatic conditions, habitat and variety of palm; thus the nuts examined by Bachofen and by Child were of Ceylon origin; by Norris from Madras Presidency; by Georgi from Malaya; and by Phillips and by Fleck possibly from the Philippine Islands. Maturity of the nut also affects the composition of its component parts, and Copeland (*loc. cit.*, p. 174) remarks that "Bachofen's nut cannot have been thoroughly ripe"; there seems, however, little reason for this statement.

The figures of Bachofen and the still older results of Lépine have been extensively quoted in the literature. Great confidence can hardly be reposed in those of Lépine, which (see Bibliography) appear to date back at least to 1861, but those of Bachofen are useful, pending the collection of further data, in that they give at least some idea of minor constituents.

In the writer's experience in Ceylon, an ash content of 0·6 per cent. is usual. Coconut

(*iii*) *Organic Constituents*.—An early analysis is that of W. L. Winton[6] in 1901, who employed the ordinary methods of Food and Drug examination for the detection of powdered coconut shell in species which adulteration he stated to be a common practice in the United States. His figures are not now of particular interest; a value of 56·19 per cent. was recorded for "crude fibre", but this is now known to have little definite relation to the structural constituents of the original material. Curious figures of Brandes, quoted by Hunger[14] are of little value.

More adequate proximate analyses have been published by Fleck[1] (1937) by the present writer[2] (1938), and by Phillips[4] (1940). The original papers should be consulted for details; the chemistry of cell-wall substances is in an active state of development and methods of analysis are still somewhat empirical. However, the three sets of observations quoted are in fair agreement over the main features of the composition of coconut shells.

(*a*) *Solvent Extractives*.—Only small quantities of material are extractable by non-hydroxylic solvents, 0·19 per cent. by ether,[1] and 0·27 per cent. by benzene.[2] Alcohol has been found to extract 2·51 per cent.[2] and a 1 : 2 alcohol-benzene mixture 4·56 per cent.[4] The manner in which coconut shells burn has given rise to the supposition that they contain considerable quantities of oily or resinous matter; this is seen not to be the case. The nature of the solvent extracts has not been examined, but the alcohol extract presumably contains some tannin matter.

Cold water has been reported to extract 1·43 per cent.[1] and 0·20 per cent.,[2] and hot water 2·67,[1] 3·57[2] and 2·76.[3] 1 per cent. caustic soda removes 20·53 per cent. of material[1] or 18·80 per cent.;[2] and 1 per cent. hydrochloric acid, 29·69 per cent. These figures are of limited theoretical value, since the alkali- or acid-soluble fractions are not clearly defined; the former, for example, includes part of the lignin and of the polyuronide and cellulosan fractions.

(*b*) *Nitrogen*.—Georgi and Gunn Ley Teik[15] give the analysis of eight samples as 0·073 to 0·090 per cent. (average 0·081 per cent.) for shells having a moisture content of 20·2 per cent. (not air-dried but fresh collected). This corresponds to an average per cent. nitrogen on dry weight of 0·10 per cent. and agrees well with the 0·11 per cent. reported by Phillips.[4]

A somewhat higher figure, 0·156 per cent. is given by Fesca.[16] The nitrogen seems to be largely associated with the lignin fraction (see below).

(c) Lignin.—The percentages of lignin reported are 33·30,[1] 36·51[2] and 27·26 per cent.[3] Methods of determination were all different and there may, of course, have been some natural variation between the samples examined. In the writer's opinion a figure of 32·0 per cent. is, probably, fairly near the true value.

Phillips gives a figure of 0·29 for the percentage of nitrogen in the lignin; this accounts for over 70 per cent. of the total nitrogen (see above).

Methoxyl.—The methoxyl content of shells has been reported as 5·39[1] and 5·84 per cent.[3] According to Phillips,[3] the lignin fraction contains 16·17 per cent. methoxyl or 16·46 per cent., calculated on the nitrogen and ash-free lignin. This accounts for 4·41 per cent. of the original. It does not, however, follow that the balance of about 1 per cent. methoxyl is associated with the non-lignin constituents of the shells, since it is by no means certain that there is no loss of methoxyl during the isolation of the lignin by strong acid treatment.

The lignin content of the shells is higher than that of most woods. Further reference is made particularly to the methoxyl content in the discussion of the distillation product of shells in a subsequent article.

(*d*) *Total Pentosans*.—Both Fleck[1] and the present writer[2] estimated pentosans by the method of Schorger, and obtained similar figures, *viz*., 30·28 and 29·27 per cent. respectively. These figures were not corrected for the presence of polyuronides. Phillips[3] determined uronic acid anhydrides as 3·82 per cent. and used an empirical formula to give a correction for the amount of furfurldehyde derived from the uronic acids; this correction came to 1·42 per cent. calculated as pentosans, and his so corrected "total pentosans" figure to 30·14 per cent.

The estimates of "total pentosans" by the three sets of workers are thus reasonably concordant. The percentage is considerably higher than in most woods and is the highest recorded for all nut-shells so far examined,[7,8,4]

No further quantitative details are available regarding the nature of the pentosans, but as long ago as 1895 Tromp de Haas and Tollens[11] obtained a "satisfactorily yield" of crystalline xylose by hydrolysis of coconut shells with 4 per cent. sulphuric and stated that this appeared to be the only product of the hydrolysis. The residue gave dextrose on further hydrolysis with stronger acid.

(*e*) *Cellulose*.—Published estimates of "cellulose" differ considerably and it is obvious that this is largely due to the methods of estimation and that the various workers were not dealing with similar "cellulose" fractions. Phillips'[3] use of the method of Kürschner and Hanak[9] seems to imply his opinion that the Cross and Bevan method or modification thereof as used by Fleck[1] and by the present writer[2] is less reliable for resistant materials like coconut shells. The wide discrepancies between the recorded percentages of "crude cellulose" become less serious when adjustment is made for the pentosan content. All the three workers determined the furfurldehyde yield of their "crude cellulose" and calculated the pentosan content in the usual way based on Krober's work:

	Fleck (1)	Child (2)	Phillips (3)
% Crude Cellulose ..	44·98	53·06	33·52
,, Pentosan in Cellulose	17·67	20·54	5·26
,, Cellulose ..	27·31	32·52	28·26

It would appear, therefore, that the "crude cellulose of each worker differed materially only in that the respective methods of treatment had removed more or less of the pentosan fraction.

No further examination of the nature of the "cellulose" has been carried out, except that Fleck determined the arbitrary "Hydrolysis No.", *i.e., the* percentage loss in weight after hydrolysis with 15 per cent. sulphuric acid, which he found to be 35·85. It may be noted that this is not markedly different from his figure for the pentosan

content of the cellulose. Fleck also determined the "holocellulose" fraction by the method of Van Beckum and Ritter;[10] this fraction, 61·0 per cent., purports to represent the entire non-lignin constituents of the cell-wall, and indeed does accord reasonably well with an estimate of 32·0 per cent. for lignin, allowing also for ash and extractives.

Further examination of "cellulose" fractions obtained in various ways seem to be desirable and a critical examination of methods of preparation. It seems safe to say, however, that the cellulose content of coconut shells is lower than that of most woods.

Boswell[8] noted that the cellulose separated from Brazil nut-shells was obtained as a hard mass whatever method of drying was used, and the writer has made a similar observation on cellulose derived from coconut shells, which was always obtained as a hard horny mass.

(*iv*) *Discussion.*—Qualitatively, coconut shells resemble, in composition, the hard woods, but they have higher contents of lignin, total pentosans and pentosan in cellulose, and lower contents of cellulose. The methoxyl content does not differ greatly from those of many woods. The nature of the products obtained by dry distillation (described in a subsequent article) show considerable quantitative differences from those of woods, and it is likely that these differences point to features in the composition of the raw material not indicated by existing analytical methods. It is believed that further investigation of the various fractions—lignin, "cellulose", pentosan, etc.,—would yield results of interest in the chemistry of cell-wall substances. This is probably also true of other nut-shells, few of which have been studied (see Refs. 7, 8, 4), but which present several novel points of interest.

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INDIA'S POST-WAR INDUSTRY

THE question of capital re-equipment of Indian industry was raised by Sir Azizul Haque, Commerce Member, in his opening address to the meeting of the Post-War Reconstruction Policy Committee on Trade and Industry, on Thursday, the 21st October 1943. "The Government of India", he said, "have by no means lost sight of this aspect of the problem which the continuation of the war, with a consequent continuation of excessive wear and tear on plant, and increased difficulty of replacement, has made more acute. In so far as those machineries and plants have to be imported from abroad, I am convinced that no time should be lost in making an aggregate estimate of India's total post-war requirements. It will be necessary, without any avoidable delay, that the Governments or organisations of exporting countries must know the approximate extent of India's post-war requirements."

All industries are asked to take up this question as soon as possible so that the Government of India might take the necessary steps in that direction. It was the duty of the Government to assist new industry and new enterprise, but the Government must also look to trade and industry to state what were likely to be the scope and prospects of such new industries. "In the exigencies of war conditions industries are necessarily organised, mobilised, and shaped to meet the exigencies of war production, but it is time for us to try to plan the future, assess the place of these war industries in post-war conditions, and give our thoughts to other human and social aspects of life, and conditions of industrial labour so that men may not decay with a mere accumulation of wealth."

Therefore, Sir Azizul added, the Government were submitting to industries for their consideration a draft questionnaire which would give them the information they sought. He also emphasised that the questionnaire was a purely provisional document, and if the industries thought that some other method of getting the necessary information was to be preferred, they could give their views. The Committee decided the terms of a questionnaire to be addressed to industries to elicit factual data on which definite plans for post-war developments could be based. It also discussed India's trade policy in the post-war period, and the future of India's industrial policy.

THE ORIGIN OF "ROHR" AT DIDWANA

BY H. B. DUNNICLIFF, C.I.E.

IN the June issue of *Current Science*, Dr. E. Spencer[1] has given an explanation of the formation at Didwana of the beds of thenardite or crystalline anhydrous sodium sulphate, locally known as 'rohr', which he claims to be more in harmony with facts than my thesis based on phase rule considerations which appeared in the January number of this *Journal*.[2]

In my desire to be brief, I omitted from that article much of the laboratory and field experimental evidence, part of which I now submit in support of my contention that the formation of sodium sulphate decahydrate antecedent to the development of thenardite is the normal sequence of events in the pans during that portion of the season when night and morning temperatures and the concentration of the brine in the pans make the hydrated salt alone or mixed with sodium chloride, the only possible solid phase according to accepted physical laws.

The manufacturing season commences about the middle of February, the first crop of salt being collected three or four months later. The season normally finishes at the end of April by which time about three lakh maunds of salt would have been harvested. If, however, the demand is great, as in 1942 and 1943 (4·24 lakh and 3·75 lakh maunds respectively), the season is extended to the end of May and even well into June, but the salt harvested in the latter months is discoloured through contamination with dust and contains increasingly high percentages of sodium sulphate.

In certain circumstances, the temperature conditions necessary for the separation of Glauber's salt may persist until about the middle of March.

Table I giving the maximum and minimum atmospheric temperatures at Didwana for the first three months of 1942, studied in conjunction with Table II (p. 296), supports this view. The brine would not attain these minima, the difference between atmospheric and brine temperature would vary with prevailing climatic conditions, the brine temperature being consistently higher than that of the (minimum) atmospheric temperature. The difference of 15° F. between pan and atmospheric minimum temperatures was observed in Saha's experimental eliminator pans (Ref. [2], pp. 9 and 10) in which the layer of brine was far deeper (up to 10 inches) than the shallow layers of brine (1½-2 inches) used by the deswals. This led to a greater retention of heat in Saha's field experiments than in the normal process of salt manufacture in which a difference of not more than + 10° F. might be expected.

Dr. Spencer's laboratory observations and conclusions have made a valuable contribution to this important subject but his experiments have not been conducted under conditions comparable with those which obtain at the salt source.

Thus, the evaporations have proceeded at an approximately uniform temperature of 90° F., which happened to be the temperature in the laboratory where the work was carried out, while, in the field, the crux of the immediate issue is not the concentration of the brine in the pans, but the difference between the relatively high temperature at which the unsaturated brine is fed into the pans, and the much lower supervening night and early morning temperatures before there has been any appreciable evaporation.

Even when some daytime evaporation takes place, fresh crystallisation occurs during the following night in the early part of the season, the deposit of Glauber's salt (which subsequently decomposes into the anhydrous sulphate) accumulating with each addition of brine.

The arguments on page 177, paras 3 and 4, and page 178, paras 1 and 2 of Dr. Spencer's

TABLE I

Maximum and Minimum Temperatures at Didwana (° F.)

	January 1942		February 1942		March 1942	
	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.
1	79	35	82	43	90	55
2	81	37	82	39	88	48
3	82	36	77	36	90	54
4	70	39	77	32	84	50
5	79	43	75	30	91	55
6	82	41	79	34	88	54
7	82	48	81	34	77	47
8	84	54	86	43	79	48
9	70	23	88	40	93	51
10	64	22	75	48	95	51
11	57	23	88	50	95	51
12	68	24	89	52	97	55
13	66	34	75	37	92	52
14	68	32	79	35	93	51
15	72	41	80	36	97	51
16	73	36	80	35	102	51
17	70	37	87	45	97	55
18	70	37	74	34	98	59
19	65	32	74	32	104	59
20	65	32	86	50	86	57
21	70	34	86	57	91	55
22	76	34	88	50	91	55
23	77	32	86	52	102	59
24	81	39	89	50	106	59
25	73	34	91	55	102	66
26	73	35	90	50	106	70
27	77	43	80	55	102	57
28	75	38	88	54	95	50
29	74	41			—	—
30	81	45			99	55
31	81	45			102	57

November 19–30, 1941: Max. 93° F.; Min. 41° F. (Max. Min. = 47° F.).

December 1–31, 1941: Max. 88° F.; Min. 35° F. (Max Min. = 48° F.).

paper[1] do not appear to me to be relevant and the discussion of the phenomenon in terms of the solutions at the sodium sulphate-sodium chloride transition points is not applicable to the general proposition. Quantities of phases in conjugate solid and liquid phases formed by chilling unsaturated solutions to temperatures at which they are supersaturated cannot be calculated by the simple subtraction of percentages, for this purpose, the appropriate isothermal or polythermal diagrams are necessary.

Dr. Spencer has, however, presented a scientific and highly probable explanation of the unexpectedly low percentage of sodium chloride in the 'rohr' when conditions are such that the two anhydrous salts must separate simultaneously. This is based on the difference between the densities of the crystals of NaCl and Na_2SO_4, assisted by the strong tendency of the NaCl to form box-like floating crystals. We have discussed this problem and I am in complete accord with Dr. Spencer's views where the anhydrous sulphate is directly deposited, but I shall show that Glauber's salt, even if co-precipitated with some sodium chloride as is normally the case, will ultimately yield the anhydrous sulphate relatively free from sodium chloride.

Table II gives the solubility relationships[3] for the system $NaCl$-Na_2SO_4-H_2O at important points.

Na_2SO_4) at which, from a solution also containing 13·6 per cent. NaCl, a mixture of Na_2SO_4, 10 H_2O and Na_2SO_4 is deposited. Between 63·5°. and 77° F., however (*vide* Table II), there would be solutions having lower concentrations of Na_2SO_4 from which the mixture of Na_2SO_4 and Na_2SO_4, 10 H_2O would separate. For a detailed study of this the full polythermal diagrams and data would be necessary.

When Glauber's salt separates from 'kul' brine containing 18 per cent. NaCl and 6 per cent. Na_2SO_4 at about 27° C. by simply cooling it to 10° C., the residual brine could only contain about 3·1 per cent. of Na_2SO_4 in presence of 18 per cent. NaCl, the balance of the Na_2SO_4 (2·9 per cent.) having crystallised out as Na_2SO_4, 10 H_2O. The removal of the water as water of crystallisation automatically increases the concentration of the NaCl so that, the curve being steep, the transition point may be reached quickly and some NaCl separate with the Na_2SO_4, 10 H_2O. This effect would be intensified at 5° C. (41° F.) (*vide* Table III) and result in the separation of a still greater proportion of Glauber's salt. In my former paper,[2] the relationship is explained with the assistance of a diagram, but an approximate calculation will help the picture. Assuming that (unsaturated) 'kul' brine at 27° C. containing NaCl = 18 per cent.; Na_2SO_4 = 6 per cent., and H_2O = 76 per cent., is cooled to 10° C., the residual brine could only contain about 3·1 per cent. of Na_2SO_4 in the presence of 18 per cent. NaCl (*vide* Table II and Ref. [3]), the balance of the Na_2SO_4 (2·9 per cent.) having crystallised out as Na_2SO_4, 10 H_2O, simultaneously removing $2 \cdot 9 \times 1 \cdot 27 = 3 \cdot 7$ parts of H_2O as water of crystallisation. In nature, supersaturation is not likely to occur. The residual brine should thus contain 18·0 parts NaCl 3·1 parts Na_2SO_4 and $(76 - 3 \cdot 7) = 72 \cdot 3$ parts H_2O or, calculated as percentages, NaCl = 19·3 per cent.; Na_2SO_4 = 3·3 per cent.; H_2O = 77·4

TABLE II

Percent. in 100 Grams of Solution

0°C. (32° F.)		10°C. (50° F.)		17·5° C. (63·5° F.)		25° C. (77° F.)		Solid Phase
NaCl	Na_2SO_4	NaCl	Na_2SO_4	NaCl	Na_2SO_4	NaCl	Na_2SO_4	
0·00	4·65	0·00	8·38	0·00	14·10	0·00	21·90	
		3·87	5·80 (*a*)					
		8·39	4·16	8·12	8·51			Na_2SO_4, 10 H_2O
10·70	1·50	13·[illegible]8	3·37					
		17·35	3·16 (*b*)	16·90	6·80	7·66	16·00	
		23·27	3·57					
25·54	1·30	24·37	3·43 (*c*)	22·30	7·31	13·53	15·42	Na_2SO_4, 10 H_2O *plus* NaCl
						13·60	14·76	Na_2SO_4, 10 H_2O *plus* Na_2SO_4
						Intermediate Concentrations		Na_2SO_4
						22·70	8·06	Na_2SO_4 *plus* NaCl

Note: Anhydrous sodium sulphate cannot form below 17·9° C. (64·2° F.)

From these figures it will be observed that:

(*i*) A solution containing only, for example, (*a*) 9·67 per cent., or (*b*) 20·5 per cent. total salts can be in equilibrium with Glauber's salt.

(*ii*) A solution containing 18 per cent. NaCl and 6 per cent. Na_2SO_4 at 25° C. (77° F.) is unsaturated but, on concentration, the solid phase which would separate would be Na_2SO_4 or Na_2SO_4 *plus* NaCl. Glauber's salt can only be a solid phase at 25° C. at high concentrations of Na_2SO_4 (minimum 14·76 per cent.

per cent. As a matter of fact, the solution is supersaturated with respect to Na_2SO_4, 10 H_2O and the result will be that some more Na_2SO_4, 10 H_2O will deposit and the point at which some NaCl also separates be attained. Accurate calculation by this method is not possible but about 50 per cent. of the sodium sulphate comes out as Na_2SO_4, 10 H_2O.

In the field, when the temperature in the shallow pans rises above the Na_2SO_4, 10 H_2O-Na_2SO_4 transition point, the decahydrate loses water and changes into Na_2SO_4. The water mixes with the liquid phase taking the NaCl (and some Na_2SO_4) with it, a process which is assisted by the stirring. Hence, even if originally contaminated with NaCl, the sodium sulphate deposited will be left behind considerably purified and the resultant composition of the liquid phase need have no relevance to the composition of the liquid phase at the NaCl-Na_2SO_4, 10 H_2O transition point.[6]

In fact, the manufacture of high grade anhydrous sodium sulphate from Glauber's salt by adding solid common salt and heating to 20-22° C. by low pressure steam, is a commercial process.[4]

Thus, at Didwana, the water crystallised out is returned to the brine and becomes mixed with it. During the cold period, after some concentration by wind and rise of temperature, a further moiety of Glauber's salt can be deposited the following night and similarly for successive days so long as temperature and concentration conditions make Na_2SO_4, 10 H_2O the only solid phase (*vide* Seidell[3]). The sodium sulphate will naturally be mixed with the sodium chloride crystallising out as stated by Dr. Spencer and, owing to the vertical direction of the curve, the transition point wlil be quickly attained after the bulk of the Na_2SO_4 10 H_2O has separated.

In an actual field experiment in which masses of the decahydrate separated overnight, the unwashed but filter-paper-dried Glauber's salt analysed as follows:

Na_2SO_4, 10 $H_2O = 97 \cdot 63$ per cent.;
$NaCl = 2 \cdot 20$ per cent.;
$Na_2CO_3 = 0 \cdot 07$ per cent.; and
$NaHCO_3 = 0 \cdot 08$ per cent.

At the daytime higher temperatures, when the Na_2SO_4, 10 H_2O passes into Na_2SO_4, the water in the Glauber's salt would make a 4 per cent. solution with the sodium chloride present and some sodium sulphate would also naturally dissolve into the liquid phase to the equilibrium point.

Laboratory Experiments

In the laboratory experiments (Ref. [2], p. 9), the results set forth in Table III which has been condensed as far as possible by giving only the Na_2SO_4 and NaCl percentages were obtained.

Raw Didwana brine (Ref. [2], Table III, Samples 2, 3, 5 and 6) was kept in a refrigerator for sufficient time for equilibrium to be established, so far as was possible without stirring, at a temperature of about 40-42° F. (5° C.). Crystals of Na_2SO_4, 10 H_2O, contaminated with NaCl, separated. Attention is drawn to the similarity of composition in Samples 2, 3 and 5, Table III (2), which corresponds to 6·35 per cent. NaCl on the crystal sulphate, Na_2SO_4, 10 H_2O. This shows that the Na_2SO_4, 10 H_2O-NaCl transition point was attained after the early separation of Na_2SO_4, 10 H_2O was completed.

TABLE III

(1) *Raw Brine*

Sample No.	2	3	5	6
NaCl	19·53%	18·49%	16·05%	16·97%
Na_2SO_4	5·95%	6·56%	7·64%	4·68%
NaCl: Na_2SO_4	3·28 : 1	2·8°:1	2·10 : 1	3·63 :1

Average about 3 : 1 (NaCl = 18%; Na_2SO_4 = 6%)

(2) *Glauber's Salt Deposit Calculated on a Dry Basis*

	%	%	%	
NaCl	13·11	13·15	13·15	—
Na_2SO_4	85·09	85·45	85·78	—

Average proportions, $Na_2SO_4 : NaCl = 6 \cdot 5 : 1$. In terms of actual components, this gives

Na_2SO_4, 10 $H_2O = 93 \cdot 7$ per cent.;
$NaCl = 6 \cdot 3$ per cent.,

and the percentage composition of the crystalline mixture becomes

Na_2SO_4, 10 $H_2O = 91 \cdot 6$ per cent.;
Na_2SO_4, 10 $H_2O + NaCl = 8 \cdot 4$ per cent.

(3) *Resultant Mother-Liquor or Purified Brine*

	%	%	%	%
NaCl	21·44	21·44	18·14	22·90
Na_2SO_4	1·98	1·45	1·88	1·75

(4) *Purity of Salt Crystallised from Mother-Liquor*

	%	%	%	%
NaCl	98·42	97·68	98·51	97·05
Na_2SO_4	0·92	1·49	0·86	1·96

These figures for 5° C., seldom attained in nature, indicate a much higher order of elimination of sulphate than those quoted above for 10° C. (50° F.). This and the variable composition of the mother-liquor is due to absence of stirring and to variations of temperature which probably often fell below 5° C., as correct thermostatic conditions could not be maintained because the refrigerator had to be used for general laboratory purposes. Even with this high percentage of sodium chloride, the water in the Glauber's salt is sufficient to give about 12 per cent. sodium chloride solution on change of phase.

I hope that these details of experiments, which were not carried out under ideal labo-

ratory conditions but with an attempted approximation to natural conditicns, will explain the possibility of the removal of half or more of the sulphate as decahydrate in a single stage under suitable temperature conditions which in fact exist for an appreciable part of the normal manufacturing season at Didwana. As explained above, the water of crystallisation returns to the liquid phase with some sodium sulphate but a second deposition of crystals takes place during the next cool night and so on.

CONCLUSIONS

I have discussed this problem with Dr. Spencer and we are agreed that the deposits are due to the two processes operating one after the other.

From mid-February to possibly about the middle of March, Glauber's salt separates and is subsequently dehydrated and deposited on the previous layers of thenardite.

This is succeeded by a short intermediate period when the hydrated and anhydrous sodium sulphate crystallise out together. For the rest (and greater part) of the season, the process described by Dr. Spencer[1] takes place. This is followed by the conversion of the finer deposits formed in either of the two ways into the massive form of natural crystalline sodium sulphate, thenardite.

Variations in the percentage of sodium chloride in the deposits may be due (*i*) to the extension of the season as in 1923 (7·49 lakh maunds); 1925 (4·02 lakh maunds); 1931 (5·34 lakh maunds), and 1932 (4·55 lakh maunds) when the demand for salt was high, (*ii*) to the incomplete purging from sodium chloride as described by myself, or (*iii*) to abnormal disturbances causing more sodium chloride than usual to separate in the process described by Dr. Spencer.

It is unfortunate that my proposal for a continuous scientific observation of the salt and 'rohr' production at Didwana was not accepted in 1941, as the results would have provided full data for the solution of this interesting phenomenon. Dr. Spencer and I are of opinion that detailed field work extending over a complete season, from November to June, including a full examination of Saha's eliminator pan proposals, is highly desirable.

SAMBHAR LAKE BITTERNS

On page 179 of his article (*loc. cit.*), Dr. Spencer makes certain suggestions regarding the separation of the components of Sambhar Lake bitterns. Elsewhere[5,6] I have described in some detail the immense saline deposits in the East Lake Bitterns Area and have also attempted to re-construct the manner in which their stratified formation has been developed. Proposals have also been made for their commercial exploitation.

Although the $NaCl:Na_2SO_4$ ratio in Sambhar kyar bitterns resembles the corresponding average ratio in Didwana brines, it is actually rather higher and the concentration of the carbonates of sodium (about 4 per cent. as Na_2CO_3) is too high to be disregarded as has been possible when discussing the crystallisation of Didwana 'kul' brines in which the carbonate percentage as Na_2CO_3 is usually of the order of 1 per cent. or under. Algal and bacterial impurities,[8] not encountered at Didwana, also complicate the problem at Sambhar.

When allowed to crystallise out in kyars reserved for the purpose, the bitterns from the manufacture of kyar salt[7] deposit "manufactured bitterns salt" of varied composition but averaging very roughly: $NaCl = 62$ per cent.; $Na_2SO_4 = 22$ per cent.; $Na_2CO_3 = 7$-8 per cent. and $NaHCO_3$ up to 3·8 per cent.[6] This salt is now being produced in commercial quantities for industrial purposes.

Characteristics of the Didwana brines are, therefore, relatively low carbonate content, absence of double salt formation and the non-interference of organic matter.

Examination of the bitterns of salt deposits which have accumulated in the East Lake Area at Sambhar over a period of nearly forty years, involves the interpretation of a five-component system:

$$NaCl\text{-}Na_2SO_4\text{-}Na_2CO_3\text{-}NaHCO_3\text{-}H_2O$$

(in which CO_2 is also present) under peculiar and annually varying conditions. The progressive crystallisation and partial recrystallisation of the bitterns has yielded vast quantities of a considerable range of sodium salts together with sodium chloride. These include sodium bicarbonate, $NaHCO_3$; sodium sesquicarbonate or crystal carbonate, Na_2CO_3, $NaHCO_3$, $2\,H_2O$; burkeite, Na_2CO_3, $2\,Na_2SO_4$ (and possibly sesquiburkeite, $2\,Na_2CO_3$, $3\,Na_2SO_4$) (*vide* Ref.,[6] layers B, C and E). In 1939, careful investigation of these stratified deposits led to the discovery near the surface of a 3-4" layer of crystal salt of excellent quality. From this stratum,[7] 13·9 lakh maunds of alimentary salt were extracted in the 1939-40 season while, in the following year, the early showers of the monsoon provided surface "washings" of concentrated brine from which 39·43 lakh maunds of kyar salt were crystallised out.

1. Spencer, E., *Curr. Sci.*, 1943, **12**, 176. 2. Dunnicliff, H. B., *Curr. Sci.*, 1943, **12**, 7. 3. Seidell, A., *Solubilities of Inorganic and Metal Organic Compounds*, D. Von Nostrand Inc., 1940, **1**, 1234–5 and *International Critical Tables*, 1928, **4**, 287. 4. Roberston, G. R., *J. Ind. Eng. Chem.*, 1942, **34**, 133. 5. Dunnicliff, H. B., *Rec. Geol. Surv. Ind.* (in the Press). 6. Auden, J. B., Gupta, B. C., Roy, P. C. and Hussain M., *Rec. Geol. Surv. Ind.*, 1942, **77**, 34. 7. Dunnicliff, H. B., *J. Sci. Indst. Res.*, 1943, **1**, No. 4, p. 270. 8. Dunnicliff, H. B., and Padwick, *J. Ind. Chem. Soc., Indust. and News Edn.*, 1943, **6**, 4.

PROF. A. V. HILL, F.R.S.

We wish to extend a hearty welcome to Prof. A. V. Hill, F.R.S., who has just arrived in Delhi at the invitation of the Government of India. He is to study on the spot the achievements of science and industry in India and to explore avenues of closer collaboration between Indian scientific workers and those of the United Nations.

LETTERS TO THE EDITOR

CENTRAL HIMALAYAN GEOLOGY

In a recent paper[1] Professor K. P. Rode has discussed the stratigraphical and tectonic successions of the Himalayan rocks of Sirmur State, and has extended his conclusions to other areas not studied by him. These conclusions are in complete disagreement with published and unpublished work of W. D. West and myself. Only a few of Rode's assumptions can be discussed within the limits of a short letter to *Current Science*.

(1) Rode states that the correlation of the Bansa limestone with the Krol limestones is "irresistible", and that the true Krol Nappe is represented by the outcrop of the Bansa limestone. In view of the absence of fossils in these rocks, correlation of necessity depends on a balance of evidence from lithology, chemical composition, thickness of stages, metamorphism and structural position. The analyses of certain Himalayan limestones and dolomites are given in the table below:—

	Mandhali	Bansa	Blaini	Lower Krol	Upper Krol	Upper Krol Marble, near Mussoorie
Number of analyses	3	7	2	7	8	12
SiO_2	12·80	27·84	6·20	27·64	0·18	0·14
$Al_2O_3+Fe_2O_3$	3·53	3·47	4·48	12·90	1·24	0·15
CaO	45·79	37·29	28·02	23·57	33·05	55·14
MgO	1·01	0·71	18·48	5·84	18·45	0·38
$CaCO_3$ calculated from CaO	81·8	66·6	50·0	42·1	59·0	98·47
CaO/SiO_2 ratio	3·58	1·34	4·52	0·85	183 5	394
CaO/MgO ratio	45·3	52·5	1·52	4·04	1·79	145
Lithology	slaty limestone and calc slate	sandy limestone and calc quartzite	pink hard siliceous dolomite	shaly limestone and calc shale	dark and pale dolomite	white marble
Thickness in feet of bands or stages	50–300	50–300	10–30	300–700	2,500–3,000	15–100
				With Krol Red Shales and dolomites the thickness of the Krol series may be taken as 3,500—4,000 feet.		

The profound differences between the Bansa and the various Krol carbonate rocks is clear from this table, and is sufficient to refute Rode's correlation on the only evidence at present available. Whatever the age relation-

ship of the Krol and Bansa rocks may ultimately prove to be, in lithological facies and structural positions they are entirely different.[2] Moreover, Rode's idea that the Bansa limestone lies in the core of a fold (his Fig. 1) is almost certainly untenable, because this limestone continues below the Chandpur series and crops out on the south side of the Tons syncline, where it dips northwards.

(2) Rode assumes that the Blaini boulder bed is a mid-tertiary tectonic breccia or conglomerate devoid of stratigraphical significance. He omits, however, the Blaini from his sections, in the places where it should have been shown, as if it did not exist, and fails to indicate the thrust planes which he postulates from its supposed nature. The Blaini boulder beds (over wide areas there are two boulder beds, separated by banded slates) and Infra Krol slates have been traced for 120 miles, constantly overlain along the Krol belt by Krol rocks. They can be followed, for example, for seventy miles round the Mussoorie basin (one of five basins of the Blaini-Krol-Tal succession east of longitude 77° 30′) in a very definite stratigraphical position. Rode is further mistaken in supposing that the occasional boulders of Dagshai-like sandstone found in the Blaini must be of Tertiary age. Such sandstones are found in the Simla slates and the Nagthat series, both almost unquestionably pre-Mesozoic formations.

(3) Rode regards the Lower Tal shales as inverted Infra Krol, and divorces them by thrust contact from the Upper Tal quartzites which he considers to be Jutogh. Our two successions may be placed side by side:—

	RODE	AUDEN
Top	Jutogh Nappe	Schists and phyllites of the Garhwal nappe, with intruded Lansdowne granite
		thrust
		Nummulitic
		Tal fossiliferous limestone
		Upper Tal quartzites (*uninverted*)
	thrust	*lithological gradation*
Bottom	Infra Krol (*inverted*)	Lower Tal shales

In uniting so many different units in his Jutogh nappe, Rode has ignored the following facts:—

(*a*) The Nummulitics between the schistose rocks and the Upper Tal:[4] (*b*) the Upper Tal fossiliferous limestone, the fossils of which are not, unfortunately, of diagnostic value: (*c*) the uninverted nature of the Upper Tal quartzites, as abundantly proved by the disposition of the current bedding:[5] (*d*) the lithological gradation between the Tal shales and quartzites, which makes them with virtual certainty one series:[6] (*e*) the meso-grade metamorphism of the Jutogh series as contrasted with the unmetamorphosed (locally epi-metamorphosed) nature of the Tal quartzites: (*f*) lithological differences between the Tal and Jutogh quartzites.

(4) Rode believes that the Chor, Dudatoli, Lansdowne and Almora granites have exerted no thermal metamorphism on the schists in which they occur, but are thrust klippen tectonically divorced from the schists. W. D. West has found that the Chor granite sinks northwards under Jutogh schists, and has in fact been intruded along the centre of a syncline of the Jutogh series. The Dudatoli and Almora granites occur in the form of lenticular sills embedded within the schists. Moreover, the Chor, Dudatoli and Lansdowne granites have all been found to have caused a superposition of thermal metamorphism upon the more general regional metamorphism.[7] The interpretation which West and I put upon the field evidence is that these granites were intruded into the contiguous pelitic sediments before the thrust movements which later brought both granite and host into their present tectonic positions. Rode's "Central Granite Thrust" does not exist, because, after crossing the great tectonic window which the writer has traced from Banchangaon (30° 54′: 78° 14′) south-eastwards to Almora, and by Heim and Gansser from Dudatoli to near the Nepalese frontier (their Calc Zone of Tejam),[8] one returns to a composite series of ortho-gneisses, paragneisses and schists, of the south face of the main Himalayan range, which is homologous with the rocks of the Dudatoli-Almora zone. The same feature is found north of the Larji 31° 43′ : 77° 13′) tectonic window towards the Rohtang pass. The massive granite around Gangotri is also clearly intrusive, lying capped by roof-pendants of metamorphosed Simla Slates, into which it has locally sent up a network of pegmatite offshoots in part responsible for the presence of garnet, staurolite and kyanite.

The verification of these points is in the field, for the most part in areas beyond those visited by Rode, but notwithstanding described by him.

Geological Survey of India,
Calcutta, J. B. AUDEN.
September 19, 1943.

1. *Proc. Ind. Acad. Sci.*, 1943, **17**, 157. 2. *Rec., Geol. Surv. Ind.*, 1942, **77**, Prof. Pap. 2, 7. 3. *Op. cit.*, 1937, **71**, 415. 4. *Ibid.*, Plate 37, Section 2. 5. *Ibid.*, 1933, **67**, 394; 1937, **71**, 417. 6. *Ibid.*, 1933, **67**, 394. 7. *Mem. Geol. Surv. Ind.*, 1928, **53**, 60–72; *Rec. Geol. Surv. Ind.*, 1887, **20**, 136, and maps 40, 143. 8. *Denkschr. d. Schweiz. Naturforsch. Ges.*, 1939, **73**, Abh. 1.

CHEMICAL EXAMINATION OF *OCIMUM CANUM* SIMS.

Ocimum canum Sims. belongs to the natural order Labiatæ and grows abundantly throughout Gujarat. Its leaves are used in skin diseases,[1] and seeds, locally known as "Tukmaria", are said to be tonic and very useful in gonorrhœa. With a view to isolate active principles from them, the investigation of the seeds, leaves, etc., of this plant has been undertaken.

The powdered seeds were successively extracted with ether, carbon tetrachloride,

alcohol, etc. The ether and carbon tetrachloride extracts yielded a yellow fatty oil (about 10 per cent). The following are the analytical constants for the oil.

Specific gravity at 30°—0·9206.
Refractive index at 40°—1·4707.
Acid value—72·15.
Saponification value—194·5.
Iodine value (Hanus)—179·8.
Unsaponifiable matter (per cent.)—1·25.
Hehner number—88·14.
Reichert-Meissl value—0·6.
Polenske value—0·3.
Acetyl value—32·1.

The chemical examination of the oil and other extracts of the seeds is in progress.

An essential oil obtained in 0·1 per cent. yield from the fresh leaves is also being investigated.

Central Excise Laboratory, C. R. MEHTA.
The Technological Institute, T. P. MEHTA.
Baroda,
September 23, 1943.

1. Watt's *Dictionary of the Economic Products of India* **5**, 442; Chopra's *Indigenous Drugs of India*, 511.

ENTAMOEBIC INFECTION IN CERTAIN CILIATES

Entamœba, which is a parasite of several Metazoa, has recently been reported to parasitize certain Protozoa, *e.g., Protoopalina, Zelleriella, Cepedea* and *Opalina* (*vide* Stabler, 1933; Carini and Reichenow, 1935; Stabler and Chen, 1936; etc.). This preliminary note is the first record of entamœbic infection from India having been availed in certain ciliates, *e.g., Opalina japonica, Opalina lata, Opalina* sp., *Cepedea longa Cepedea longa hispanica, Cepedea* sp. (Fig. 1),

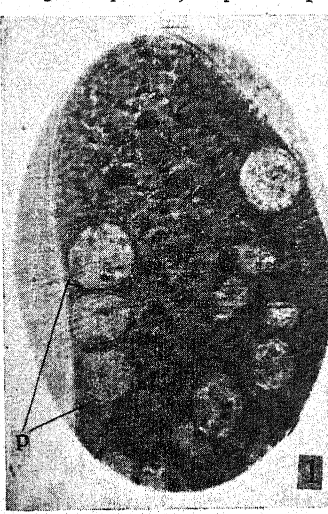

FIG. 1.—A portion of *Cepedea* sp. showing entamœbæ (p). × 1000 *cir.*

Nyctotherus cordiformis, and *Nyctotherus* sp. found in *Rana limnocharis* Wiegm, *R. tigrina* Daud, *Bufo himalayanus* Bouleng., and *B. melanostictus* Schneid. Moreover, certain opalinids, *Opalina* spp., and *Cepedea* sp. collected from *Varanus monitor* have also been found to be hyper-parasitized by entamœbæ.

In vivo entamœbæ appear as refractile bodies within the opalinid ciliates, but are not so conspicuous within the bodies of the Nyctotheri. The presence of entamœbæ does not appear to affect the normal vital activities of the ciliates, except in acute infections when the ciliates become impoverished.

In fixed and stained preparations the parasites appear morphologically identical with *Entamœba ranarum,* except that they are smaller in size (trophozoites 4·0 μ-16·9 μ; cysts 6·6 μ-12·4 μ). The cysts are invariably uninucleate; glycogen vacuoles and chromatoids also occur within them. The nuclei of the trophozoites and those of the cysts are of the "histolytica-type".

It may be that the parasites become incorporated within the bodies of the Nyctotheri *per os,* but in the astomatous opalinid ciliates the entrance of the parasites would be possible only by direct penetration (Fig. 2).

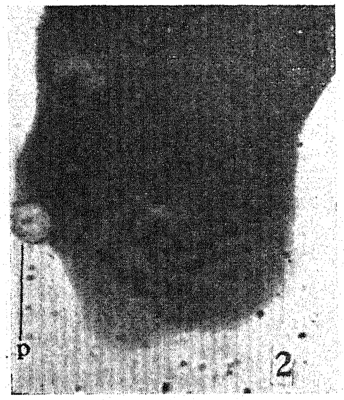

FIG. 2.—A portion of *Opalina* sp. showing entrance of the parasite (p). × 833·33 *cir.*

Certain opalinid cysts collected from the amphibians and the lizard were found to contain entamœbæ, but these parasites were never detected in the cysts of the Nyctotheri. Such opalinid cysts, according to Stabler and Chen, constitute an important method of transmission of the entamœbæ from adult amphibians to their tadpoles through the medium of water. But it is difficult to account for the transmission of the opalinid cysts in *Varanus,* which lays eggs on land and has no tadpole stage at all.

Walker (1909) has described "sporulation" in certain ciliates, *e.g., Nyctotherus multisporiferus, N. parvus, Balantidium falciformis* and *B. coli,* but Sassuchin (1928) doubts this and believes that Walker mistook the fungus, *Sphærita,* (which Sassuchin found in *Nyctotherus ovalis*), for the "spores" of the ciliates. The present author, however, believes that the objects which Walker called "spores" were really entamœbæ. For instance, the so-called "spores" seen in his Figs. 1, 2, 3 and 4 on Pl. 14, and

Fig. 8 on Pl. 15, resemble the parasites seen in the photomicrograph (Fig. 3) accompanying

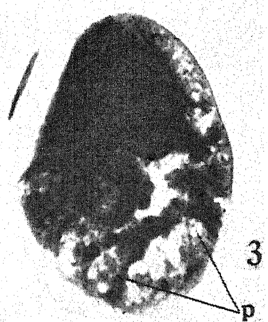

FIG. 3.—*Nyctotherus* sp. showing entamœbæ (*p*) × 333·33.

this paper. Walker's Fig. 5 on Pl. 15, seems to represent not enlarged "spores", but deeply stained entamœbæ invaded by certain micrococci and the so-called "remnant of the broken down sporocyst" enclosing these "spores" is, in all probability, an artefact formed by aggregation of bacteria and other extraneous matter.

Zoology Department,
University of Lucknow,
Lucknow, P. L. MISRA.
August 28, 1943.

1. Chen, T. T., and Stabler, R. M., *Biol. Bull.*, 1936, **70**, 72. 2. Sassuchin, D. N., *Arch. f. Protistenk.*, 1928, **164**, 61. 3. Stabler, R. M., and Chen, T. T., *Biol. Bull.*, 1936, **70**, 56. 4. Walker, E. L., *Arch. f. Protistenk.*, 1909, **17**, 297.

SELACHIAN FAUNA OF BOMBAY WATERS

VERY little concentrated work has been done on the systematics of Indian Elasmobranchs since Dr. Day's time (1889), and complete records of their life-history hardly exist. An opportunity to add to the literature was afforded during investigation of the Selachian fauna occurring along the Bombay coast. Studies spread over a period of two years and a half have established the occurrence of 40 species of sharks, skates and rays as represented in the table below:—

Family—Orectolobidæ: Genus—*Chiloscyllium*, *C. griseum* Muller and Henle; *Ginglymostoma*, *G. ferrugineum* (Lesson); *Stegostoma*, *S. tigrinum* (Forster); *Rhineodon*, *R. typus* Smith.

Family—Odontaspidæ: Genus—Odontaspis, *O. tricuspidatus* (Day).

Family—Carcharhinidæ: Genus—*Scoliodon*, *S. sorrakowah* (Cuvier), *S. pallasorrah* (Cuvier), *S. walbeehmi* Bleeker, *S. species*, Sp. Nov.; *Hypoprion*, *H. macloti* (Muller and Henle); *Carcharinus*, *C. limbatus* (Muller and Henle), *C. melanopterus* (Quoy and Gaimard), *C. bleekeri* Duméril, *C. menisorrah* (Muller and Henle), *C. species*, Sp. Nov.; *Galeocerdo*, *G. tigrinus* Muller and Henle; *Hemigaleus*, *H. balfouri* Day; *Eugaleus*, *E. species*, Sp. Nov.; *Galeorhinnus*, *G. musteleus* (Linné).

Family—Sphyrnidæ: Genus—*Sphyrna*, *S. blochii* (Cuvier), *S. zygœna* (Linné).

Family—Rhinobatidæ: Genus—*Rhynchobatus*, *R. djiddensis* (Forskal).

Family—Pristidæ: Genus—*Pristis*, *P. cuspidatus* Latham, *P. perrotteti* Muller and Henle.

Family—Trygonidæ: Genus—*Trygon*, *T. uarnak* (Forskal), *T. variegatus* Annandale, *T. alcockii* Annandale, *T. gerradii* Gray, *T. bleekeri* Blyth, *T. walga* Muller and Henle, *T. sephen* (Forskal), *T. zugei* Muller and Henle; *Pteroplatea*, *P. pœcilura* (Shaw).

Family—Myliobatidæ: Genus—*Ætomylœus*, *A. maculatus* (Gray and Hardwicke); *Ætobatus*, *A. flagellum* (Schneider); *Rhinoptera*, *R. javanica* Muller and Henle.

Family—Mobulidæ: Genus—*Mobula*, *M. eregoodootenkee* (Cuvier), *M. mobular* (Bonnaterre).

Family—Torpedinidæ: Genus—*Narcacion*, *N. species* Sp. Nov.; *Narcine*, *N. timlei* Bloch and Schneider.

A glance at the above list shows that four species are new and these forms as well as the species *Mobula mobular* are recorded for the first time from Indian waters. With the exception of five species, namely, *Ginglymostoma ferrugineum*, *Stegostoma tigrinum*, *Rhineodon, typus*, *Odontaspis tricuspidatus* and *Narcacion* sp., the rest may be said to be fairly common along the Bombay coast, where they figure regularly in the catches of the fishermen.

Fisheries Section,
Department of Industries,
Bombay, S. B. SETNA.
August 10, 1943.

SOME FACTORS ASSOCIATED WITH FLORAL ABNORMALITIES IN CALENDULA

IN some of the pots of Calendula, it was observed that even after the cessation of flowering and subsequent formation of seeds, small flower buds sprang up from the same receptacle which later showed normal flowering and seed setting. The number of such secondary capitula may be anything from 1 to 10, the largest up till now noticed. The occurrence is more common in the orange-yellow variety than the pure yellow one. Two kinds of such flowering were noticed. In one case, the secondary capitula came out from underneath the receptacle in a way resembling the very common occurrence in daisy (*Bellis perennis*) and in the second case, they came out from the top middle portions of the receptacle. The second type were more common.

Seeds from the original and the secondary capitula were collected separately and it was observed that the seeds from the original receptacle germinated freely, flowered and set seeds. The seeds from the secondary receptacles failed to germinate.

In ordinary flower-beds, the occurrence is usually 1 or 2 per 100 capitula. But recently some Calendula beds were noticed where the frequency counted at different periods appeared to be about 40 per 100. This observation led to the suspicion that soil conditions might have had something to do with supply of mineral matter to the soil and hence double flower formation. Analysis of the representative soil samples from such beds showed no remarkable difference in chemical composition from soils from ordinary beds. Only known difference was in watering, which was exceedingly irregular and scanty in beds where the frequency of abnormal flowering was high.

It is generally considered,[1] that abnormalities in flower do not occur, as we generally think, according to freaks of nature but due to definite effects of abnormal climatic conditions, or conditions of nourishment. It is also known[2] that lack of adequate moisture tends to develop reproductive portions to a greater extent and under the same climatic conditions, less moisture supply in one case means absorption of more mineral salts than in the other.

With this view in mind, an attempt was made to see whether secondary flower formation was associated with the absorption of more mineral matter than in plants bearing no abnormal flower.

Since it was seen that the same plants may have branches both containing abnormal flower formation and also the normal ones it was thought probable that the difference existed only between the branches and not in the original plants and consequently only the branches were cut off and used in analysis.

Three types of branches were studied: (1) The branches just before ordinary flowering, (2) just after complete setting of seeds where there was no subsequent double flowering and (3) just after first seed setting and before the formation of complete secondary buds. Stalks, leaves and the receptacles in a single branch were taken separately. In the receptacle care was taken to remove florets and seeds, leaving the real receptacle. In cases of abnormal flowering, the secondary buds, if any, were removed. Before subjecting to analysis, the plants were washed with distilled water to remove any adhering dust particles. pH, moisture, nitrogen, ash, P_2O_5 and K_2O were estimated.

pH values of the plant saps of the abnormal flowering branches did not show any remarkable deviation from the pH values of the other branches. In all the cases, the receptacle was more acid than the stalk or leaf juices.

The results of analysis of the different portions indicate fairly well, the greater absorption of K_2O, P_2O_5 and mineral matter in general from the soil by the abnormal branch. It may be, therefore, fair to assume that this absorption of extra mineral matter is responsible for further growth. The mineral matter content of the abnormal flowering branch was not at all exhausted as was the case with the normal one. Even after the first flowering and seed setting it maintained the same potentialities as a branch before first flowering. The detailed results are given below:—

	just before flowering	just after formation of seeds	abnormal flowering
Moisture %			
stalk	90·4	85·7	82·9
leaves	80·3	79·1	63·4
receptacle	80·5	74·1	75·0
Nitrogen %			
stalk	2·64	1·32	1·39
leaves	4·14	3·48	2·43
receptacle	3·62	2·33	1·95
Ash %			
stalk	28·01	12·53	24·69
leaves	32·63	16·29	34·73
receptacle	16·95	9·87	24·55
P_2O_5 %			
stalk	1·09	0·72	0·68
leaves	0·90	0·74	0·76
receptacle	1·31	1·01	1·27
K_2O %			
stalk	6·83	2·41	7·61
leaves	4·85	4·07	5·47
receptacle	4·35	3·26	5·62

It appears possible that the double flowering may be associated with irregular water supply where some plants are made to absorb extra amount of mineral matter under drought conditions, when the concentration of plant food materials is much more than when the soil is normally moist.

My grateful thanks are due to Rao Bahadur B. Viswanath and Dr. B. P. Pal, for many helpful criticisms and valuable suggestions.

Imperial Agricultural Research Institute, New Delhi,
September 29, 1943.

ABHISWAR SEN.

1. Wordsdell, W. C., *The Principles of Plant Teratology*, 1916, **2**, 18–30. 2. Smith, J. W., *Agricultural Meteorology*, 1920, p. 84.

ABNORMAL CIRCULATION IN THE COMMON INDIAN FROG *RANA TIGRINA* DAUD.

ABNORMALITIES in the circulatory system of Anura are numerous. Those in the common European frog *Rana temporaria* have been reported by Crawshay (1906), Collinge (1915), Flattely (1926), Lloyd (1928), Grove and Newell (1934) and O'Donoghue (1932, 1933, 1935). A number of Indian workers (Ahuja, 1921; Bhaduri, 1929 *a* and *b*; Khatib Husain, 1938; Mathur and Sharma, 1938) have described abnormalities in the vascular system in *Rana tigrina*.

I have found the following abnormalities in a female specimen of *Rana tigrina*:—

I. *Venous abnormalities*.—(1) A persistent right posterior cardinal vein joining the innominate vein on the right side and the absence of the post-caval vein. (2) The presence of two dorso-lumbar veins on each side joining the renal portal veins.

II. *Arterial abnormality*.—An additional arterial branch arising from the Carotid arch.

Venous Abnormalities.—The absence of the post-caval and the persistence of the right posterior cardinal.

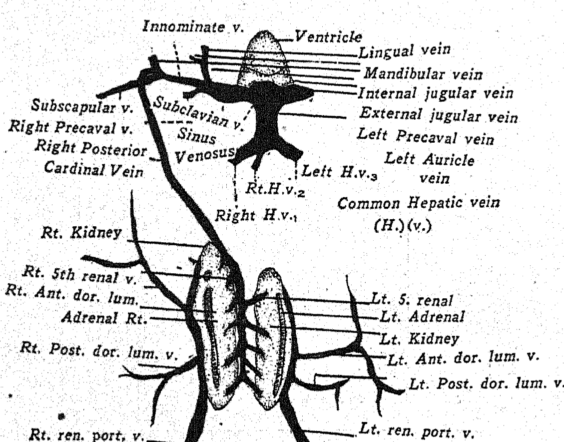

FIG. 1 ×·5

Rt. Ant. dor. lum., Anterior dorso-lumbar vein; *Rt.*, Right; *Lt.*, Left; *Rt. ren. port. v.*, Right renal portal vein; *Rt. Post. dor. lum. v.*, Right posterior dorso-lumbar vein; *Lt. ren. port. v.*, Left renal portal vein.

Fig. 1 illustrates the venous abnormalities. The post-caval is replaced by the persistent right posterior cardinal. The kidneys are dissimilar in size and the renal veins of the right side are more in number than those on the left side correlated with the larger size of the right kidney. The presence of two dorso-lumbar veins is also seen. So far as the veins from the liver are concerned, two hepatic veins arise from the right lobe of the liver while only one arises from the left. All these fuse to form a single hepatic vein which opens directly into the sinus venosus since the post-caval is absent.

Arterial Abnormality.—This is interesting since arterial abnormalities occur far less frequently than venous ones. The left Carotid arch gives origin to an abnormal artery before the point of origin of the lingual artery. It gives off two branches, one of which joins the lingual artery while the other supplies certain muscles (Fig. 2).

The ventral view of the heart showing only the left aortic arches.

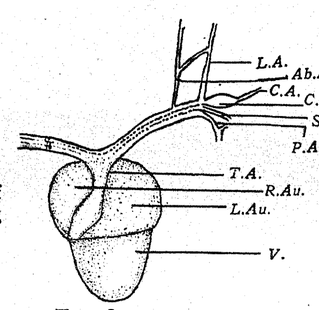

FIG. 2 ×·75

Ab.A., Abnormal artery; *C.A.*, Carotid artery; *C.G.*, *Carotid Gland*; *L.A.*, Lingual artery; *L.Av.*, Left Auricle, *P.A.*, Pulmocutaneous arch; *S.A.*, Systemic arch; *T.A.*, Truncus arteriosus; *R.Au.*, Right auricle, *V.*, ventricle.

My best thanks are due to my colleagues and also to Principal Dr. K. Krishnamurti for their advice and encouragement.

Department of Zoology,
College of Science,
Nagpur,
September 7, 1943.

THAKUR S. B. SINGH.

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A NEW VARIETY OF *DROSERA INDICA* LINN. FROM KOLHAPUR (S.M.C.)

IN an intensive study of the flora of Kolhapur (Deccan) three types of the insectivorous plant, *Drosera* are met with. Two of these are the commoner species, *Drosera indica* Linn. and *Drosera Burmanni* Vahl., already described. Cook[1] mentions a few localities from the

Bombay Presidency where these are found naturally, but not Kolhapur. Roxburgh[4] refers to them as natives of Coromandel, Ceylon, etc. Their occurrence, therefore, in Kolhapur is interesting from point of view of their distribution.

Drosera Burmanni Vahl. was collected at Radhanagari hills (a place of heavy rainfall) while *Drosera indica* Linn. was found at Katyayani hills (with much less rainfall), in marshy places.

A third variety of *Drosera*, also collected in a marsh near Gokulshirgaon—very near to the city, differs from *Drosera indica* Linn. in possessing red flowers instead of the usual white ones, while it agrees in other characters very closely. It also flowers in September.

This third type appears, therefore, to be a distinct variety of *Drosera indica* Linn., not recorded by Cook.[1] This may not be the same as that referred by I. Pfleiderer[3] and V. Mayuranathan[2] as having "pinkish" flowers.

The following new nomenclature is, therefore, proposed:—

Flowers white .... *Drosera indica* Linn. var. *alba*.

Flowers red .... *Drosera indica* Linn. var. *rubra* Parandekar et Diwan.

Biology Department,
Rajaram College,
Kolhapur,
September 16, 1943.

S. A. PARANDEKAR.
M. G. DIWAN.

1. Cook, T., *Flora of the Bombay Presidency*, 1901. 2. Mayuranathan, V., *Bulletin of the Madras Govt. Museum*. 3. Pfleiderer, I., *Glimpses into the Life of Indian Plants*. 4. Roxburgh, W., *Flora indica*, 1874.

PRODUCTION OF ELEMENTARY SULPHUR BY REDUCTION OF SULPHATE THROUGH BACTERIAL AGENCY

IN the course of investigations on microbiology of some anærobic bacteria at the Imperial Agricultural Research Institute, New Delhi, an organism, which reduces sulphate to elementary sulphur, has been isolated both from soil collected from the bottom of an irrigation channel and materials from the anærobic fuel gas plant set up at the chemical laboratory. Although the reduction of sulphates to sulphides in the presence of organic matters has been known for a long time, no mention has been made in literature of any organism producing elementary sulphur by reduction of sulphate. The organism appears to be a new one of the kind as is evident from the morphological characteristics and biochemical tests. The organism is a gram negative, non-spore forming short rod. It grows in Dunham's solution in the presence of sucrose, lactose, maltose, raffinose, levulose, mannite, salicine, and glycerine with no gas and acid. The organism ferments glucose with production of gas and acid and reduces nitrate to nitrite and ammonia. It neither curdles nor peptonises milk. It does not reduce litmus milk. The organism grows well in Van Delden's lactate asparagine liquid medium of the following composition:—K_2HPO_4 0·5 gm., Sodium lactate 5·0 gm., Asparagine 1·0 gm., $MgSO_4$ or $CaSO_4$ 1·0 gm., $FeSO_4$ Traces, and Tap water 1,000 c.c. In this medium about 30-35 per cent. of sulphur present in calcium sulphate is reduced to crude elementary sulphur in about a week's time. For the estimation of crude elementary sulphur 50 c.c. of the inoculated culture medium were evaporated to dryness on water-bath. The dried mass was treated with carbon disulphide and then filtered on a tared porcelain dish. The carbon disulphide was then evaporated to dryness. The substance extracted by carbon disulphide was then weighed as crude elementary sulphur. Further test for sulphur was made by oxidising it with nitric acid and precipitating the sulphate with barium chloride.

The production of hydrogen sulphide could not be detected at any stage as no blackening of lead acetate paper occurred during the course of reduction.

The possibility of this organism producing sulphur from sulphate by composting with organic matter is being studied. A paper on the subject will be published later.

Imperial Agricultural
Research Institute,
New Delhi,
September 15, 1943.

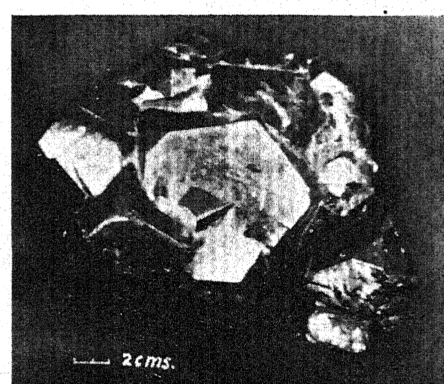
S. C. DATTA.

PYRITE CRYSTALS FROM THE ALMORA DISTRICT, UNITED PROVINCES

PYRITE is a widely distributed mineral and occurs in formations of various ages, and its crystals are quite common. However, on account of the large size of the crystals the above occurrence is worthy of record.

The crystals occur in greenish schistose phyllites at two localities, Chowkoree (29° 50·5′: 80° ·2′) and near the bank of Sarju river E.N.E. of Khani (29° 47′: 70° 47·5′).

From the former locality the crystals are cubes, which are somewhat distorted and show



a pseudo-tetragonal symmetry. The edges of the largest crystal measure 19 mm. One of the crystals showing the pseudo-tetragonal symmetry can be seen towards the right in the photograph.

From the latter locality, in addition to the cubic crystals, pyritohedrons are also common. The largest crystal in the collection (see photograph) has octahedral faces on it. The longer edge of the largest pyritohedral face measures 31 mm. and the edge of the octahedral face measures 6 mm. The crystals are grown one into another giving an aspect of inter-penetration twinning. The intergrowth of crystals seen in the photograph weighs 1,005 gm. A chemical analysis of the crystals gave:—Sulphur 53·46 per cent., Iron 45·36 per cent.

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University of Lucknow, R. C. MISRA.
September 29, 1943.

INFLUENCE OF POTENTIAL AND NATURE OF RADIATION ON THE NEW LIGHT-EFFECT IN CHLORINE UNDER ELECTRICAL DISCHARGE

EARLIER results[1,2,3] on the production of a new light-effect, *viz.*, Δi the diminution on irradiation of i the discharge current, were observed under conditions selected chiefly to reveal the main phenomenon, within the range and sensitivity of the then available indicator. This precluded a wide-range investigation of the nature of Δi changes, when all except one of the determining factors were unaltered. Thus, *e.g.*, whilst Δi, the light-effect, was quite marked over a wide range of V the applied potential using a violet light-filter, it was just detectible with red, employing any of the familiar, intense light sources and maximum V. This limitation was absent using the Cambridge A.C. microammeter, which has both improved and simplified appreciably the whole technique of the study of this new phenomenon.

Fig. 1 records results for Δi observed with the above instrument as V was varied over an

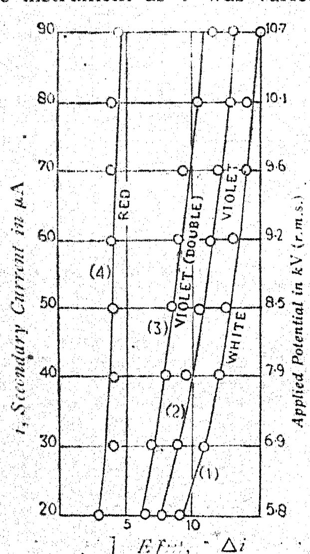

FIG. 1

appreciable range; the corresponding values of the secondary current are also indicated. The light source was a 200 watt bulb run at 180 volts. In agreement with earlier results[2b] for Δi due to a fixed V, it is seen that the light-effect with the violet filter (curve 2) is substantially similar to that for unfiltered white light (curve 1), and that comparatively, Δi due to red is markedly low. The use of a pile of two violet filters (curve 3) as against one (curve 2) illustrates the effect of a reduction of intensity in diminishing Δi.

In relative units, the total incident energy corresponding to the white, violet, violet (double filtered) and red was 34·1, 16·5, 8·7 and 22·2 respectively. These results suggest that frequency is more important than the intensity in the production of this phenomenon.[2,3] That violet is more absorbed than red by chlorine is an additional factor.[2b,3] It may also be mentioned that within the limitations of the means at our disposal this light-effect was found to be negligibly small in the infra-red.[3] It is interesting that the general influence of an increase of V in increasing the light-effect in chlorine is but small and is comparatively sensible under the white or the violet light, when Δi is large.

Benares Hindu University, S. S. JOSHI.
September 2, 1943. P. G. DEO.

1. *Curr. Sci.*, 1940, **9**, 536. 2. (*a*) *Nature*, 1941, **147**, 806; (*b*) 1943, **151**, 561. 3. *Proc. Ind. Sci. Cong.*, Pres. Address to Chem. Sec. (1943), pp. 70–75.

THE INDUCED OXIDATION OF HYDRIODIC ACID WITH VANADATE AS INDUCTOR

THE reaction between vanadate and hydriodic acid has been studied by numerous workers but the course of the reaction is not yet definitely established. Perkins[1] and Gooch and Curtis[2] among others found that the amount of iodine liberated was in excess of that corresponding to the equation

$$V_2O_5 + 2HI \rightarrow V_2O_4 + I_2 + H_2O.$$

We have conducted experiments to determine the total amount of iodine liberated in the presence of air under varying concentrations of vanadate and hydrogen ion. It was found by us that when the hydrogen-ion concentration was kept constant the discrepancy between the experimental and theoretical amounts (according to the above equation) of iodine increased with the decrease in the concentration of vanadate; when the vanadate concentration was kept constant the discrepancy increased with decreasing concentration of the hydrogen ion.

Ramsay[3] stated that the theoretical amount of iodine corresponding to reduction of pentavalent vanadium to the tetravalent stage is indeed obtained when the reaction is allowed to take place in an atmosphere of carbon dioxide excluding the presence of air. Experiments conducted by us in an atmosphere of carbon dioxide and in vacuum under widely varying concentrations of vanadate and hydrogen ion showed that the amount of iodine liberated in the absence of oxygen corresponds quantitatively to reduction to the tetravalent

stage. These experiments rule out the suggestion of earlier workers[4] that the excess liberation of iodine observed in the presence of air may be due to the reduction of the pentavalent vanadium being carried beyond the tetravalent stage. We have carried out experiments to see if this excess liberation of iodine in the presence of air is due to (*a*) the simple autoxidation of hydriodic acid by atmospheric oxygen catalysed by tetravalent vanadium or (*b*) the oxidation of hydriodic acid by atmospheric oxygen induced by the primary reaction between vanadic acid and hydriodic acid. We found that at the hydrogen-ion concentration employed in the experiments the liberation of iodine due to cause (*a*) is negligible and cannot account for the enormous liberation of iodine actually observed. The excess liberation of iodine observed in the presence of air is, therefore, due to the induced oxidation of hydriodic acid. We also found that the induction factor (F)

$$F = \frac{\text{Number of molecules of hydriodic acid oxidised by oxygen}}{\text{Number of molecules of hydriodic acid oxidised by vanadic acid}}$$

varies with concentration of vanadate and hydrogen ion. Recently we[5] reported that oxalate ion catalyses the reaction between vanadic acid and hydriodic acid. The presence of the catalyst also influences the magnitude of the induction factor.

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Andhra University,
September 25, 1943.

C. R. VISWANADHAM.
G. GOPALA RAO.

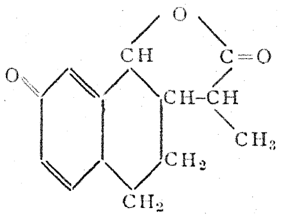
1. Perkins, *Amer. J. Sci.*, 1910, **29**, 4, 540. 2. Gooch, and Curtis, *Ibid.*, 1904, **17**, 4, 41. 3. Ramsay, *J. Amer. Chem. Soc.*, 1916, **38**, 2369. 4. Ditz and Bardach, *Z. anorg. chem.*, 1915, **93**, 97. 5. Viswanadham and Gopala Rao, *Curr. Sci.*, August 1914, No. 8, 229.

AN ABSOLUTE ASYMMETRIC SYNTHESIS

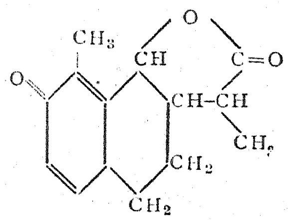
AN absolute asymmetric synthesis consists in the preparation of an optically active molecule without using at any stage of the synthesis an optically active reagent and without using any of the methods of resolution. Some cases of asymmetric synthesis using polarised light, etc., have been reported but an unequivocal synthesis without the use of such agencies has not been reported. Such an asymmetric synthesis has now been observed for the first time in our work on the synthesis of santonin and related compounds.

The synthesis of santonin (IV) has already been reported.[1] Using similar methods we have prepared compounds (I), (II) and (III).

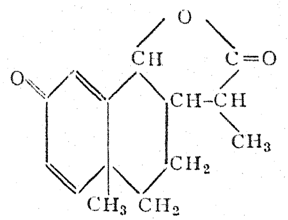
As all these compounds were expected to be racemic an attempt was made to resolve them by the usual methods. Compounds (I) and (II) were really racemic and could be readily resolved through their strychnine salts into the dextro and lævo forms. The dextro form of (I) had $[\alpha]_D^{28^\circ} = +112$ and its lævo form



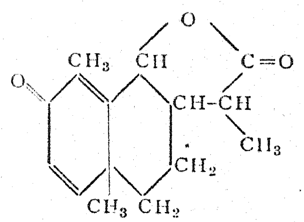
(I)



(II)



(III)



(IV)

had $[\alpha]_D^{28} = -112$. Similarly the dextro form of (II) had $[\alpha]_D^{28} = +158\cdot5$ and the lævo form had $[\alpha]_D^{28} = -158\cdot5$.

The synthetic samples of (III) and (IV) were on the other hand optically active with $[\alpha]_D^{28} = -104$ and $[\alpha]_D^{28} = -154$ respectively. (IV) was converted into the sodium salt and fractionally precipitated as the strychnine salt by strychnine hydrochloride or strychnine. From the strychnine salt precipitated, on decomposition, it was possible to regenerate (IV) having $[\alpha]_D^{28} = -172$ (m.p. 171) identical with natural santonin. The filtrates from above gave a lævo rotatory compound having $[\alpha]_D^{28} = -108$ (m.p. 171) but no dextro rotatory isomer could be isolated. Thus an absolute asymmetric synthesis had occurred at some stage of the synthesis of these compounds. Our previous statement that synthetic santonin was racemic, therefore, requires correction. A careful study of the various stages for optical activity revealed that asymmetric synthesis must have occurred either during methylation of the formyl derivative or during its subsequent condensation with the ketone. All the rotations were determined in chloroform solution.

Further work on the mechanism of this asymmetric synthesis is in progress.

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N. L. PHALNIKAR.
B. V. BHIDE.
K. S. NARGUND.

Maharaja Pratapsinh
Chemical Laboratory,
Sir Parashurambhau College,
Poona,
November 11, 1943.

1. *Curr. Sci.*, 1943, 150. 2. *Rasayanam*, 1943, **8**, 201

REVIEWS

Theoretical Organic Chemistry. By J. B. Cohen. Revised Edition by P. C. Austin. (Macmillan and Co., Ltd., London), 1942. Pp. viii + 622. Price 10/-.

The latest revised edition of this most popular book on Theoretical Organic Chemistry should be welcome to all students beginning the study of the subject. The book is noted for its clear and concise exposition of the subject which is supported by a large number of carefully selected experiments for illustrating the main reactions of Organic Chemistry. Nearly sixty pages of additional matter have been added since the first edition appeared, and descriptive details for the preparation of important compounds have been included. The general arrangement of the original edition has been adhered to, the enlargement of the text being mostly confined to Parts II and III. Two new chapters have been introduced in Part I—one on stereo-chemistry, and the other on the electronic theory of valency. These two chapters have replaced those on ureides and proteins, the latter having been transferred to Part III, in which a new chapter has been added on compounds of biological importance. In this, the beginner is given a general idea of some of the recent developments which have taken place in vitamins, hormones, plant-pigments, etc. Apart from these, slight additions are noticeable in almost every chapter in the book. The electronic theory of valency, which has now attained such importance, might have been given a more prominent place in the book, and electronic formulæ for organic compounds and interpretations on the basis of this theory of many of the important reactions of organic compounds, such as those of nitro-paraffins, iso-nitrites, etc., might have been given throughout the book in appropriate places. These are, however, minor deficiencies, and the book may be safely recommended to our students of the B.A. and B.Sc. (Pass) classes.

B. B. D.

Organic Chemistry. By Sarkar and Rakshit. (H. Chatterjee & Co., Ltd., Calcutta). Revised and enlarged second edition. Pp. 576. Price Rs. 6.

This book is meant to be a text-book in organic chemistry for B.A. (Pass) students. It covers almost the same course as given in *Theoretical Organic Chemistry* by Cohen or *Organic Chemistry* by Perkin and Kippings, Vols. I and II.

The book is divided into 46 chapters of which the first five deal with the general methods such as purification of substances, detection and estimations of elements and determination of molecular formulæ, etc. The next 24 chapters deal with aliphatic portion while the last 17 chapters are devoted to aromatic compounds. Each chapter begins with the most important members of a group of organic compounds followed by general methods of preparation of such compounds and notes on their industrial importance. At the end of each chapter are given exercises bearing on the subject-matter dealt with in the chapter.

A special feature of the book is the pointed reference it makes to the industrial importance of the substances to India. On this account the book makes a stimulating reading even to the general public. The treatment is complete and the information given is up to date. The illustrations are attractive, the printing is clear and the typographic errors are surprisingly few. The book can be heartily recommended as worthy of consideration as a text-book for B.A. (Pass) students.

K. S. N.

FISHES OF LAHORE

Fauna of Lahore—5: "Fishes of Lahore". By Nazir Ahmad, *Bull. Dept. Zool. Panjab Univ.*, 1, 253-374; 49 figs. and 1 map (July 1943). (Published by the Punjab University.) Price Rs. 4.

The *Ad hoc* Fish Committee of the Advisory Board of the Imperial Council of Agricultural Research, in its meeting of the 9th November 1937, in considering practical development of fish industry in India, expressed the opinion that

> "In order to effect development upon satisfactory lines, it was necessary to carry out local surveys of the amount and class of fish available and in this connection proper identification of the fish caught in each area was essential."

From the above it will be clear that the proper study of the fish fauna of a locality is a condition precedent to the development of its fishery resources. Viewed from this standpoint, the publication of *Fishes of Lahore* is a welcome addition to a number of articles that have appeared in recent years, such as *Fishes of Northern Bengal*, *Fishes of Travancore*, *Fishes of Mysore*, *Fishes of Hyderabad*, and the results of faunistic surveys carried out by the Zoological Survey of India from time to time in different parts of the country.

The author of the *Fishes of Lahore*, off and on, spent two years in making a thoroughly representative collection of the local fishes occurring within a radius of about fifteen miles from the Zoological Laboratory, Government College, Lahore. After a preliminary identification of the species with Day's standard works on Indian fishes, he took the trouble to compare his specimens with the named material in the collection of the Indian Museum and to consult literature in the library of the Zoological Survey of India for nomenclatorial purposes. A certain amount of information on the bionomics and life-histories of the species studied are also given either from personal

observations or from earlier records. The result of all this labour is the production of a thoroughly reliable and fully illustrated handbook of the fishes of Lahore, which should prove invaluable to fishery administrators interested in the fish supply of Lahore. Owing to the limited scope of the series, "Fauna of Lahore", of which *Fishes of Lahore* is the fifth contribution, the author had to leave out such species which though marketed in Lahore, are imported from far off stations. Fortunately in reviewing the records of fishes from Lahore, the author has indicated a number of such forms, the addition of which to the 49 species described by the author can give an almost complete picture of the fishes sold at Lahore. Though undertaken purely as an academic piece of research at a University centre, a monograph of this nature has great practical value, as it can form the basis of works like *Common Food Fishes of Shanghai* and *Common Marine Food Fishes of Hong Kong,* which have already been reviewed in this *Journal.* For the collection of fishery statistics, a work of this nature is indispensable.

Both the author and the publisher are to be congratulated on this excellent production which, though not entirely free from blemishes, is beautifully printed and well got up.

S. L. H.

RELIGION AND SCIENCE

Science, Cause, and God. By J. B. Freeman, The Hogarth Press, Madras. (The Author, Apud Auctorem, Chingleput), 1943. Pp. 341. Price Rs. 7-8-0 or 12*sh.*

Notwithstanding the fact that the relation between Science and Religion is perhaps the most persistent problem which challenges human intellect and to which evidently no permanent solution could be found satisfactory alike to the scientific and the religious conscience, any attempt to focus or concentrate attention on the different aspects of the problem surveyed historically or genetically and to suggest some suitable way out deserves unreservedly to be welcomed by the world of scientists and religionists. Father Freeman's work; the second revised and enlarged edition of which is now under notice, is a systematic and sustained attempt to analyse as fully and completely as possible the philosophical and scientific implications of the concept of *Cause* undertaken with the palpable motive of demonstrating that *God* is to be understood as the *Cause* of the Universe. Part I, entitled the "Survey of Knowledge", contains *five* chapters devoted respectively to "Mathematics", "The Concrete Sciences", "The New Outlook in Physics", "The Human Sciences", and to "Relativity". Part II, which contains *eighteen* chapters, constitutes the main portion of the book dealing with the analysis of the concept of Cause. I would invite the attention of your readers to Chapter 3—particularly to page 174, and to Chapter 12—specially to page 258 for an unequivocal statement of the author's central or cardinal position. "This first cause Uncaused, this first perfection Unperfected, this pure form we call *God*" emphatically states the author. There are other statements in other contexts which emphasize the same truth.

When statements like these are categorically made difficulties begin to confront those engaged in scientific research understood strictly within the jurisdiction of laboratory discipline devoted to qualitative and quantitative analysis. Unless supremely significant reservations are made and re-interpretations of the concept of Cause resorted to a strict orthodox laboratory scientist would be perfectly entitled to contend that an uncaused First Cause is right though riddled with contradictions. For, among the well-known weapons of experimental analysis nothing would seem to secure under the established conditions of verification such an uncaused Cause. The author has found from Whitehead, Jeans, Eddington and others to show that some of the modern scientists have abandoned the *Deterministic Outlook,* and recognised the existence of "intuition of free will". That would not take one very far or far at all. The human free-will on even a superficial analysis would appear readily as hemmed in on all sides with countless restrictions, and as surrounded by a veritable barbed wire fence of determinisms, evolutionary, hereditary, environmental, and even individual. Assuming for the sake of argument that somehow there is human free-will, that would lead to no evidence whatever in support of the existence of an uncaused First Cause. A difficulty like this cannot be lightly or light-heartedly dismissed. Christian Theists like the author have to face it and remove it. So have the Indian Vedantins. But, neither the vedantic nor the Christian theological solution can be forced down the throat of scientists who may contend that laboratory evidence for the existence of an uncaused First Cause is not forthcoming. The author has traced the countless vicissitudes of the concept of Cause since the days of Hume, and after a discussion of post-Humian ramifications has brought down the discussion to contemporary philosophy to Bergson, Radhakrishnan and others. Here again the conclusions lead us nowhere and the criticism of the different European and other Western system-builders found in Radhakrishnan's *Reign of Religion in Contemporary Philosophy* on which the author sometimes relies for support is totally unfounded and untenable as the main argument stands vitiated by a deliberate and disingenuous assumption that Absolute Idealism or Monism is the only rational or fashionable philosophy of life and that pluralistic and theistic systems owe their origin to the interference of religious prejudice with strict metaphysical speculation!! While the author presses Radhakrishnan's critique of Russell into service, he himself clean throws overboard the self-same Radhakrishnan's Absolute Idealism or Monism. From this elaborate excursion into the works and arguments of these "thinkers" only one rational conclusion can be drawn. The conclusion is that the peculiar type or variety, or species of causality which points to *God* as the Uncaused First Cause of the entire creation

would by its very nature and constitution *never admit of laboratory verification* which is the one goal of all modern scientific methodology.

Not in any manner or by any means to disparage the undoubtedly excellent work of the author but, merely to illustrate definite difficulties that confront the inquirers, I would invite the author's attention to a remarkable and sensational treatise by Dr. Beutner (London, Chapman and Hall, 1939) entitled *Life's Beginning on the Earth* (reviewed by me in a previous number of *Current Science*), towards the end of which the conclusion is thus indicated: "..... life is not a sort of miraculous separate entity, imposed on our earth by a spirit or an invisible something ... Life is one of the developments of the Universe governed by the general laws of nature" (p. 222). If all sciences that pursue the methodology of the laboratory control refuse to proceed beyond the conclusion just indicated, *they cannot be blamed*. For, on the plane or level of investigation conducted through the instrumentality of qualitative and quantitative analysis, no other conclusion would at all be possible.

This need not, would not mean any disparagement of all metaphysical effort and endeavour that have characterised the higher thought of mankind throughout the ages. Other methods, other methodologies, other weapons, other hypotheses, and other criteria of verification would have to be admitted to be functioning and operative, and it would be *ultra vires* to question or challenge the validity of these from the standpoint accepted by the laboratory disciplines. Trite as it may seem the need of the hour is that *Religion should grow more religious*, and *Science should grow more scientific*. It is *not* the other way about. The contention that Religion should grow scientific and that Science should grow religious is totally untenable.

Modern Psychology has admitted a multilateral or multi-dimensional development of human personality and complete critical caution and circumspection and strictest scientific scrutiny would co-exist in perfect harmony with religious belief. There is no use of forcing down the throat of a scientist the religious beliefs and solutions. Nor is there any of forcing down the throat of the religious the solutions of science. Sir Richard Gregory, the talended Editor of *Nature*, in his arresting volume entitled *Religion in Science and Civilization*, has argued with striking emphasis, clarity, and breadth of philosophical and scientific vision that both Science and Religion are the products of evolution of *homo sapiens* on this planet and both should be treated and evaluated accordingly. One cannot dictate to the other. For, any attempted dictatorship of the one over the other spells dire disaster.

I desire to make just one more comment in conclusion. The author speaks of first establishing causality and then arriving at the existence of God (p. 281). There is exactly the rub. He refers to a stage "prior to causality" and styles it the potential speaking likewise of potentialities—"able to give" and "able to get". But, then, the potentialities *qua* potentialities must have a being which has to be explained and evaluated in reference to the all-comprehensive concept of causality. Are the potentialities *Uncaused*? For, the author definitely writes "prior to causality". Even the use of "prior" would indicate the existence of TIME *not necessarily* "per accidens".

Be that as it may, the author should endeavour to stabilise his notions of Indian theories. He would have "Vaiseshika", the "Satkarya-vada", and "Vivarta-vada" correspond to "Scientific", "the Metaphysical", and the "Mystical" points of view (p. 253). These *are not* mutually exclusive species of the same genus, for, each can be well claimed to be all patterned into *triune*. *Vivarta-vada* definitely connotes *illusionism* but, mysticism does *not* necessarily mean any illusionism at all. Dr. Freeman's book is an effervescent stimulus, and stimulant a crisp challenge to modern scientific and philosophical thought. I expect scientists and philosophers would properly respond to it—not armchair pseudo-scientists and pinchbeck philosophers, but, those of the two categories worth their salt.

R. NAGA RAJA SARMA.

Cretaceous Rocks of South India. By. L. Rama Rao. (Lucknow University Studies XVII), 1942. Pp. 78. 4 Figs.

This publication contains two lectures delivered at Lucknow University Palæobotanical Laboratory in December 1940, which give an excellent conspectus of the knowledge we possess of a number of isolated patches of marine cretaceous strata in Trichinopoly District, near Vridhachalam, Pondicherry and in the vicinity of Rajahmundry. These rock-formations give us a glimpse into one of these rare and transient episodes in India's geological history when the Deccan along its marginal belts was submerged under the sea. Mr. Rama Rao has dealt with each individual cretaceous outcrop in detail, giving its extent, stratigraphic succession, its rock and fossil contents and the geological horizon indicated by the recent examination of the micro-fauna and flora, more particularly the latter, in which Mr. Rao and his collaborators have made a useful contribution. Niniyur division of the Trichinopoly Cretaceous is, on the evidence of the fossil algal contents of the nodular limestones as well as of the embedded flints and cherts, assigned an age astride of the youngest Cretaceous and basal Eocene.

The four figures show the geographical distribution of these interesting rocks and give a helpful picture of the areal extents these rocks must have spread over at a time when the eastern shores of India, from Assam to Trichinopoly, had suffered their deepest invasion by the waters of the Southern Sea.

D. N. W.

SCIENCE NOTES AND NEWS

Quinine Substitute.—Dr. U. P. Basu, Bengal Immunity Research Laboratory, Calcutta, writes:—

In August issue of your esteemed Journal, *Current Science* (1943, No. 8, p. 236), it has been mentioned that Laverain is being manufactured on a bulk scale in India, and it will be a really effective substitute for quinine. The main substance present in this tablet would be the quinoidine which is usually a black pitch-like mass and consists of the residual amorphous bases left in quinine factories after the four primary cinchona alkaloids and their reduction products, the dihydro bases, have been extracted. It may be cheap febrifuge but its value as an anti-malarial drug is small. Generally it is used as an accelerator in vulcanising rubber. As such, it is a question whether in a country like India where malaria takes a large toll of life and where the shortage of quinine is being so keenly felt by the population, a product like Laverain might be considered to be a substitute at all for quinine.

Rainfall in Mysore in the Months of September and October.—The months of September and October are the wettest months in the year for the Maidan parts of the State. On an average about 40 per cent. of the annual rainfall is gauged in these two months. In a number of years it has been noticed that a comparatively dry September is followed by a wet October and *vice versa*. To see if the relation is real, the following correlation coefficients were determined between the rainfall for these months for all the districts in the State. The data for 50 years (1893-1942) have been taken into account.

Districts	Cor. coefficients
Bangalore	− ·38
Kolar	− ·38
Tumkur	− ·35
Mysore	− ·31
Chitaldrug	− ·40
Hassan	− ·01
Kadur	+ ·33
Shimoga	+ ·31
State	− ·25

According to Fisher's table V-A in *Statistical Methods*, correlation coefficients with the value 0·35 and above are significant for values of $P = \cdot 01$. Thus the relation is significant for the Maidan districts except Mysore. For the Malnad districts—Kadur and Shimoga—the positive correlation indicates that the rainfall departures for September and October have generally the same sign but the correlation is below the level of significance.

The relation may be explained as follows. The Maidan parts of the Mysore State have heavy falls of rain just before the setting in of the South-West Monsoon, *i.e.*, in May or just before the withdrawal of the Monsoon, *i.e.*, in September or October. Earlier withdrawal of the Monsoon means comparatively heavier total for September and later withdrawal, a heavier one for October.

1. Henry, *The Plant Alkaloids*, 1939, p. 404 (Churchill Ltd). 2. Sollmann, *A Manual of Pharmacology*, 1936, p. 562 (W. B. Sanunders Co.).

Palaeobotany in India.—The fourth Report on the Progress of Palæobotany in India for the year 1942, published annually by Prof. Birbal Sahni of Lucknow, with the co-operation of a Committee, has been recently issued. As usual the materials studied are arranged in the order of age, and range from the Carboniferous to the Pleistocene formations in India. Most of this work we owe to the Lucknow School of Palæobotany—except that on the Cretaceous and Tertiary algæ, which is being done at Bangalore. Among the several items of research recorded in the Report, special mention may be made of the following: (*i*) Mr. D. D. Pant's investigation of the Bacchus Marsh Tillite of Australia, which has yielded a surprisingly rich microflora of species which must have lived contemporaneously with the glaciation; and similar investigations of the microflora from the Dwyka tillite of South Africa. (*ii*) Further contributions to our knowledge of the Rajmahal flora—especially the recent discovery at Onthea by Messrs. V. B. Shukla and G. S. Puri, of about a dozen well-preserved flowers of *Williamsonia*, referable to at least two species. (*iii*) More detailed studies of the flora of the Deccan intertrappean series by Prof. Sahni and co-workers, which have resulted in several fresh discoveries of fossil plants of outstanding interest and importance, such as the presence of a new genus *Rodeites* (allied to the modern *Regnellidium*) which represents the first undoubted fossil record of the Marsileaceæ; the occurrence of *Sahnianthus*, one of the best preserved flowers, the study of which confirms the suggestion already made that this flower belongs to the plant of which the fruit has been known as *Enigmocarpon Parijai*; and the de scription of the first and only known fossil *Chara, sensu stricto* named *Chara sausari* from the intertrappean cherts near Sausar. The Report also gives a brief account of the further contributions made by Mr. S. R. N. Rao (Bangalore) to our knowledge of the rich algal flora from the Cretaceous beds of the Trichinopoly and Pondicherry areas; he has also recently taken up the study of the fossil algæ from the early Tertiary Dunghan limestone of Baluchistan.

The Report under review gives a fuller and more readable account than in previous years, of the palæobotanical work being done in

India and contains several illustrations (text-figures and plates) of the more interesting finds. The usefulness of this publication is thus considerably enhanced, and we have no doubt that the Report will be much valued and appreciated by all workers in the field of palæobotany.

Imperial Agricultural Research Institute, New Delhi.—The following students of the Institute have been awarded the diploma of the Institute (Assoc. I.A.R.I.) after completion in September 1943 of their two-year post-graduate course and the acceptance by the Institute Council of theses sumbitted by them:

Botany: (1) Mr. A. V. Gokhale, (2) Mr. N. S. Reddy, (3) Mr. Abdul Alim, (4) Mr. Mohd. Sulyman, (5) Mr. M. B. Patkar, (6) Mr. R. K. Bansal.

Chemistry: (1) Mr. S. K. Vardhan, (2) Mr. M. L. Mathur.

Mycology: Mr. M. K. Hingorani.

Entomology: Muzaffer Ahmad.

Sugarcane Breeding: (1) Mr. Harkaran Singh Rana, (2) Mr. Rais Dulah Khan Emazie.

National Institute of Sciences of India.—At the meeting of the Council of the National Institute of Sciences of India, held on the 26th October 1943, in the rooms of the Royal Asiatic Society of Bengal, Calcutta, the following were declared to have been elected Ordinary Fellows:—

(1) Dr. E. L. G. Clegg, D.Sc., M.I.M.M., Director, Geological Survey of India, Calcutta; (2) Dr. A. K. Das, D.Sc. (Paris), (Dr. d'etat), Meteorologist, Meteorological Office, Calcutta; (3) Dr. P. De, M.B. (Cal.), F.R.C.P.E., Professor of Physiology, Medical College, Calcutta; (4) Mr. Verrier Elwin, Fellow, Morton College, Oxford, Honoraray State Anthropologist, Bastar State, Gorakhpur, C.P.; (5) Prof. G. P. Majumdar, M.Sc., Ph.D. (Leeds), Professor of Botany, Presidency College, Calcutta; (6) Dr. B. Mukerji, M.D., D.Sc. (Michi.), F.A.Ph.S. (U.S.A.O.), Offg. Director, Biochemical Standardisation Laboratory of Government of India, Calcutta; (7) Prof. Raj Nath, Ph.D. (Lond.), D.I.C., Professor of Geology, Benares Hindu University, Benares; (8) Dr. H. Rakshit, D.Sc. (Cal.), F.Inst.P., Assistant Lecturer in Physics, Calcutta University, Calcutta; (9) Mr. M. S. Randhawa, M.Sc., I.C.S., Deputy Commissioner, Rae Bareli, U.P.; (10) Prof. R. C. Ray, D.Sc. (Lond.), F.I.C., Professor of Chemistry, Science College, Patna; (11) Dr. S. B. Setna, Ph.D. (Cantab.), F.R.M.S., Fishery Officer, Bombay; (12) Dr. P. V. Sukhatme, Ph.D., D.Sc. (Lond.), Statistician, Imperial Council of Agricultural Research, New Delhi; (13) Dr. G. R. Toshniwal, D.Sc., Lecturer in Physics, Allahabad University, Allahabad; (14) Dr. B. P. Tribedi, M.B. (Cal.), D.B. (Lond.), Professor of Pathology, Medical College, Calcutta, and Bacteriologist to the Government of Bengal, Calcutta.

MAGNETIC NOTES

Magnetic conditions during October 1943 were less disturbed than in the previous month. There were 8 *quiet* days, 20 days of *slight* disturbance and 3 days of *moderate* disturbance as against 12 quiet days, 16 days of slight disturbance, 1 day of moderate disturbance and 2 days of great disturbance during the same month last year.

The quietest day during October 1943 was the 14th and the day of largest disturbance was the 24th.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days	
	Slight	Moderate
6, 13–16, 18, 21, 23.	1–5, 7, 8, 10–12, 17, 19, 20, 22, 25, 27–31.	9, 24, 26.

No magnetic storm occurred during the month of October 1943 while two magnetic storms were recorded during the same month last year.

The mean character figure for the month of October 1943 was 0·84 as against 0·71 for October 1942.

M. V. Sivaramakrishnan.

We acknowledge with thanks the receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 91, Nos. 4646-4647.

"Agricultural Gazette of New South Wales," Vol. 54, Pt. 9.

"Chemical Products and Chemical News," Vol. 6, Nos. 9-10.

"Indian Farming", Vol. 4, No. 5.

BOOKS

Science, Cause and God. Second Edition. By J. B. Freeman. (Higarth Press, Madras), 1943. Pp. 341. Price Rs. 7-8-0 or 12*sh.*

Testing Radio Sets. Fourth Edition. By J. H. Reyner. (Chapman and Hall, Ltd., London), 1943. Pp. 215. Price 15*sh.*

ERRATA

Vol. 12, p. 233, note entitled "The *Kurram santonica*": para 1, line 7, *for Kurram santonin read Kurram santonica*; at the end of the note, *for* 'M. A. Qazilbash' *read* 'N. A. Qazilbash'.

Vol. 12, p. 279, note entitled "Virus Diseases of Potatoes in India": para 1, line 7, *for* 'particuarly' *read* 'particularly'; para 2, line 7, *after* 'to' *add* 'plants with', and *after* 'symptoms' *insert* a comma; line 14, *for* 'such' *read* 'the'; para 3, line 6, *for* (*Solanum* virus 2)' *read* '(*Solanum* virus 2)[1]'; para 4, line 5, *after* 'U.P.' *add* 'and elsewhere,'; second column, para 2, line 2, *for* colon after 'plants' *use* full stop.

1146-43—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

CURRENT SCIENCE

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ASTRONOMICAL RESEARCH IN INDIA: III

ASTRONOMY makes an instinctive appeal to all cultured persons. Of a different nature is the interest it has for the physicist. As indicated in an earlier article, the observational discoveries of astronomy have had a profound influence on physical thought. *Vice versa*, the speculatively-minded physicist turns naturally to the facts of astronomy to find in them a confirmation of his ideas or at least some support for them. This inter-play between astronomy and physics has been vastly more active during the last thirty years, since Niels Bohr put forward his Keplerian model of the hydrogen atom and offered an intelligible explanation of the observed spectra of both terrestrial and astronomical sources of light. The influence of Bohr's theory of atomic structure on astronomical and astrophysical research has indeed been no less remarkable than its influence on the sciences of physics and chemistry. The interpretation of the spectra of the sun, the stars, of the nebulæ, of inter-stellar clouds, and nearer to us, the spectra of the major planets and of the comets has been notably advanced and aided by the simultaneous advance in our knowledge of the structure of atoms and molecules and by laboratory investigations on the light emitted or absorbed by them under various conditions. The more recent advances in our knowledge of the structure of atomic nucleii and of their transmutations has similarly exercised a profound influence on speculative astronomy, and stimulated discussion on the internal constitution of the stars and the origin of the vast outpouring of energy from them which we witness daily. The work of the astronomical theorist on these problems has necessarily to be based on the results of terrestrial experimentation and on such inferences from them as are justified by established physical principles having the widest generality. Such work has a claim to acceptance which would not be extended to *ad hoc* hypotheses and speculations having no solid basis of experience behind them.

It is not surprising that the general advance of scientific activity in India during the past thirty years has been accompanied by an increased interest on the part of Indian physicists and mathematicians in the problems of astronomy, astrophysics and cosmology. The contributions by them to these sciences have not passed unheeded by the professional astronomers in other countries. Indeed, it may be claimed without exaggeration that the influence of Indian work in this field has been surprisingly great in proportion either to its volume or the actual effort put into it.

Astronomy, however, like all other sciences, depends for her progress mainly on the work of those who have devoted their lives exclusively to her service. Surveying the contribution of India to astronomy during recent years, one of its most heartening features is the work done by the Nizamiah Observatory at Hyderabad (Dn.) under its present Director, Rao Saheb T. P. Bhaskara Sastri. The equipment of this Observatory is comparatively modest and consists principally of an eight-inch photographic telescope and a fifteen-inch visual instrument. This equipment has been used mainly for co-operating in the great international undertaking known as the "Carte du Ceil" which

consists in making a detailed photographic survey and chart of the stellar universe. Regular observations of the variable stars is also part of the programme of the Nizamiah Observatory. The reports of the International Astronomical Union bear testimony to the speed and thoroughness with which the undertaking has been carried forward. The twelve volumes of the *Hyderabad Astrographic Catalogue* published by the Observatory form an impressive record of its work. Numerous short papers arising out of the variable star observations have also appeared in the scientific periodicals.

Though not actually "made in India", the work of S. Chandrasekhar, now Professor of Astrophysics at Chicago University, has a claim to notice in an article on astronomical research in India, if only as an indication of what could be accomplished in this country under favourable conditions. It would require an entire number of *Current Science* and not a paragraph or two to sketch the many fields of astronomical and astrophysical research traversed by Chandrasekhar and the results obtained by him during the last fifteen years. The *Monthly Notices* of the Royal Astronomical Society during the years Chandrasekhar was at Cambridge, and the last ten volumes of the *Astrophysical Journal* since he went to the United States bear witness to his energy, the strength and range of his scientific interests and his powers of investigation and exposition. His two treatises on "Stellar Structure" and "Dynamics of Stellar Systems" published by the Chicago University Press make his work in the respective fields conveniently accessible to specialist and non-specialist alike. A memoir on "Stochastic Problems in Physics and Astronomy" which appeared as the January 1943 issue of the *Reviews of Modern Physics* establishes links between the problems of stellar astronomy and those arising in colloid chemistry, and is a very remarkable effort in scientific synthesis.

In concluding this series of articles, the writer ventures to express the hope that they will not altogether fail to accomplish their purpose, namely that of impressing on all those interested in the scientific and cultural progress of India, the need for making generous provision for the promotion of astronomical study and research in our country, of encouraging those who are interested in the subject, and of making it possible for Indians working in their own country to contribute to its progress.

C. V. RAMAN.

SRI JAYACHAMARAJENDRA INSTITUTE OF INDIAN MEDICINE, BANGALORE

ON the occasion of the Laying of the Foundation Stone of Sri Jayachamarajendra Institute of Indian Medicine at Bangalore held on December 11, 1943, His Highness the Maharaja of Mysore declared:—

"I have watched with interest the researches made in this country from time to time in the indigenous systems of medicine. For want of facilities or due to other circumstances, they do not seem to have been conducted on modern recognised lines. It is only exhaustive investigation based on scientific methods in a well-equipped laboratory that will help the achievement of definite results of permanent value.

The rapid spread of education and the introduction of the more scientific and systematic methods of allopathy have led to the neglect of our ancient Ayurvedic and Unani systems of medicine. No one can deny that many indigenous drugs and medicinal preparations are potent and valuable. But the days of blind belief in the authority of the written word are gone and any system of medicine must stand scrutiny by the searching eye of accurate observation and experiment. A careful and assiduous application of modern scientific methods of chemical and biochemical research into the actions and uses of our indigenous drugs can alone convince a thinking public. I am, therefore, glad to note that the aim and object of this Institution is not merely to train pupils in the art of preparing and modes of using the medicinal preparations for which Ayurveda and Unani are noted. It will be a centre for organized research, on modern scientific lines, into the actions and uses of our indigenous drugs and herbs.

The advent of allopathy has made it imperative to import from foreign countries large quantities of drugs and medicines, many of which are expensive. I hope that every attempt will be made, by diligent research in this Institution, to find out simple and inexpensive substitutes which will be within the reach of even the poorest class of patients.

It has been said that no two practitioners of Ayurvedic or Unani prepare their medicines according to the same formula. There is great scope for improvement in this respect; and *the standardization of indigenous medicines* may very well be another object deserving of consideration in this Institute.

I should like to see greater *mutual understanding, a spirit of give and take, and more co-operation between the practitioners of indigenous systems and allopathy.* After all, where a patient's ailment is concerned, it is his speedy recovery and restoration to good health that counts, and not the particular method of treatment adopted, and faith plays no small part in the process of healing. This Institution, I expect, will be a meeting place for all practitioners—indigenous and allopathic alike."

SCIENCE AND THE PUBLIC WELFARE

By Prof. A. V. Hill, F.R.S.

WE'VE long felt in England that there's a vacant chair in the Councils of the allied scientists now meeting together in the West—for consultation, co-operation and research in connection with the war and for the reconstruction which will follow some day. That chair belongs to Indian scientists and we want them to come and fill it. I've said so myself a good many times. For some curious reason which I can't understand, because I'd never taken part in politics before, I became a member of Parliament in 1940, for Cambridge University: and in the very first speech I made in the House—I confess I was very frightened—I said in a debate on India that if by some chance my voice were heard there I hoped it might help a little to make people realise that however difficult in some fields co-operation might be, in the scientific field it was easy, practical and of great importance for our common welfare.

That was three and a half years ago and I've gone on saying it since, and others have said it; and in the last few years we've elected four distinguished Indian scientists as Fellows of the Royal Society—which *some* people feel is the greatest honour any one can have next to the V.C.! Now it is an old dodge, when some one makes himself a nuisance by going on saying that something ought to be done, to reply "well, do it yourself", and to appoint him chairman of a committee to consider the matter. That usually disposes of him and his complaint for good. This isn't exactly what happened, but in the end the Royal Society sent me as its representative to India to look into scientific matters here, particularly in relation to co-operation between Indian Science and the rest of us. Whether people thought that would dispose of me I don't know—I don't think so, judging from the extreme friendliness with which I have been received here—but if they did they are quite mistaken—I'm not a bit disposed of, and intend to go on saying the same thing louder and louder until every one gets thoroughly tired of it.

The full title of the Royal Society—which was founded in 1662—is the Royal Society of London for Improving Natural Knowledge. Its cousin in Philadelphia, founded by Benjamin Franklin in 1743, is called the American Philosophical Society for improving *useful* knowledge. Notice the difference between English and American—we knew that natural knowledge was useful but didn't say so, and they did. The Royal Society has a Royal Charter given to it 281 years ago. It's entirely independent of the Government, but all through its long history it has co-operated with the Government in a number of scientific and practical questions, for example, in the voyages of discovery of Captain Cook, in the work of the War Food Committee in the last War, in directing the work of the National Physical Laboratory, and in 1939 in constructing the Central Register of Scientific Personnel for the Ministry of Labour. More recently still the War Cabinet Scientific Advisory Committee was set up under the Lord President of the Council, consisting of the three principal officers of the Royal Society and the three principal scientific officials of the Government. In all this friendly and familiar co-operation between an entirely independent body and the Government you have a typical example of an essential principle in our British organisation—which other people, if I may say so humbly, might be wise to copy—the deliberate reconciliation of order with freedom. I hope it may not be long before a single Indian scientific body crystallises out, as an opposite number of the Royal Society, with similar functions and influence, a similar independence and a similar Charter from the Government. I think I can say that when it does the Royal Society will be proud and happy to enter into the same friendly and familiar co-operative relations with it as it has already with the National Academy of Science at Washington and with other similar bodies.

The first Indian Fellow of the Royal Society was elected 102 years ago. The latest, Sir Shanti Swarup Bhatnagar,—my friend Dr. Bhatnagar was elected this year. The four who have been elected lately have been unable—owing to the war—to attend in London for their formal admission to the Society. The President has asked me, while I'm in India, to act on his behalf and to take a suitable occasion of admitting these gentlemen to the Society; and of getting them to sign their names on a sheet of parchment which will later be inserted in the Charter Book in which all our Fellows have signed their names ever since 1662. This duty I hope to be able to perform at the meeting of the Indian Science Congress in January and His Excellency the Viceroy, whose grandfather and great-grandfather themselves were Fellows of the Society, has promised to attend. And on that occasion I hope to give the Indian Science Congress messages of greeting from Sir Henry Dale, the President of the Royal Society, from Sir Richard Gregory, the President of the British Association, and from two other famous Fellows of the Royal Society, *viz.*, Field-Marshal Smuts, and Mr. Winston Churchill, whose ancestor—Sir Winston Churchill—the father of the great Duke of Marlborough, was himself one of the first Fellows of the Society.

I've talked rather a lot about the Royal Society, partly because I'm here as its representative, partly because I've no time to go into details and want to talk about principles. And the fundamental principle of all good Government, as I see it, is the friendly and familiar co-operation of independent institutions and people of good-will with Government—for advice, for criticism when necessary, for co-operation. We must expect, in the present development of the world, a great growth of Government machinery: and a bureaucracy is bound to become sticky, sterile, overbearing

and inefficient unless it continually tries—or is forced—to meet healthy independent opinion. In scientific matters the Royal Society is typical in Britain of that healthy independent opinion. Moreover, if the Governments of different countries are to work with one another—as they must if the world is not to remain chaotic—they can best learn to do it, not directly, but through the familiar contact of their independent citizens with one another. The fact that the Governments of Great Britain, U.S.A., and the Dominions are now collaborating so efficiently in scientific research and technical development in connection with the war is not due simply to their own good sense, but because the scientists and engineers of these countries knew each other so well that they forced collaboration on their Governments. The scientists of all the United Nations are working together now with a degree of unanimity and good-will which is due, partly indeed to a common cause, but at least equally to the fact that such collaboration is a common tradition of science, the tradition of many centuries of experience and good fellowship. That tradition will continue anyhow and we may hope that a common cause will remain too, after the war's over. That common cause will be the improvement of human welfare, in knowledge, health, agriculture, nutrition, industry, communications, education,—and freedom from want, sickness, ignorance and fear.

All this common machinery of scientific research and development which we've created for the war, both for defence and offence and for maintaining a stable base of health and welfare at home, must not end suddenly when the war's won but must be carried over gradually to deal with the problems of individual, national and international reconstruction; and then—when that's complete, if it ever is—for human betterment on an international scale.

If any one dares to say that all this will cost too much, we must insist that the cheapest and most certain method of human betterment is the improvement, in Benjamin Franklin's words, of useful knowledge. If a country's poor and undeveloped let us spend *more* on research not less: the amount we can possibly spend is insignificant—only 1 or 2 per cent. of the national income anyhow—and will bring a very handsome dividend. As Herbert Agar says this is a time for greatness—we must either be great or dead—and one important element of greatness is intelligence. Stupidity and ignorance are not campatible with greatness.

In what ways can science help us directly in promoting human betterment? In England now we are contemplating a vast expenditure on housing, in the next twenty years, £2,000 million or 2,600 crores of rupees. One per cent. of that spent on research, on design, materials, building, heating, lighting, ventilation and amenities, will certainly make the new houses many times one per cent. better, healthier and more efficient. We are, in fact, already devoting whatever effort we can spare from the war to research on building. We mine 20 crores of tons of coal annually—1 per cent. of its cost spent every year on research will certainly improve the efficiency of its utilisation by many times 1 per cent.; we're intending to spend half at least of that by a joint co-operative effort between Government and the industry. There are 60 million people in the Colonial Empire. The Colonial Research Committee, under the Chairmanship of Lord Hailey, is able to spend £500,000 or 6½ million rupees annually of Government money as soon as research workers are free from their war duties. Its purpose is by research to improve the welfare of the Colonial peoples. It sounds a lot but it only comes to one or two annas a head. Your Department of Scientific and Industrial Research is allowed to spend 10 lakhs of rupees per annum. It's doing very fine work for your country, as I've seen already for myself, but the cost is only 1/25th of an anna for each inhabitant of India. It could usefully spend ten times as much. Your annual budget now I'm told is 600 crores of rupees; 1 per cent. of that's 6 crores. My scientific friends in India would be very happy indeed if they could look forward to anything like that. In England I suppose we spend £50 million a year on medical treatment and to this might be added several times the amount for time and health wasted owing to preventable disease. Medical research in all its forms does not spend more than 1 per cent. of that. The Industrial Research Associations in England spent in 1938 about half a million pounds—a very small fraction of 1 per cent. of the annual value of British industrial production. I want my listeners to get one very simple idea into their heads—1 per cent. It does'nt sound very much. Let us aim at giving 1 per cent. of our national budget, 1 per cent. of the value of our industrial and agricultural production, 1 per cent. of the loss due to ill-health, 1 per cent. of the cost of our food, our transport, our houses, our water, our coal, even our broadcasting, to research—and in ten years we shall find that we're getting back not 1 per cent., but 10 or 20 or 40 or 200 per cent. in dividends. During the last War there was a picture in *"Punch"* showing the proprietor of a sweet shop changing the label of his Turkish Delight to British Delight. It was called 'Honesty is the best policy'. Research is like honesty—the best policy.

You'll see that I pitch my claims high, but I'm *not* selling you a nostrum. If the history of modern industrial development had taught us nothing at all, the history of the present war would have taught us that to neglect research is to invite calamity. The Battle of Britain depended on the courage and skill of a few brave young men in Hurricanes and Spitfires—but it depended also on the knowledge and skill of a few young scientists sitting behind cathode-ray tubes. The battle of the Atlantic has depended on the courage and skill of sailors and airmen, but it has depended also on the scientists and engineers who devised and used the means of intercepting the U-boats and confounding their devices. The fact that in spite of our hardships the health and good humour of the people in Britain is at least as high as in ordinary times has depended on vigorous administrative action based on

knowledge of nutrition, health and even applied psychology. So, in days to come, the reconstruction of Britain, Europe and the world will depend on courageous and far-sighted planning based on science applied to industry by co-operative effort, to health, to agriculture, to transport, housing, raw materials and a proper survey of natural resources.

I cannot claim as yet to have much direct knowledge of Indian problems but it's clear to me that three of the greatest problems of India—really they make a single problem—are biological ones, those of agriculture, health and population. These all act and react on one another and they react with the other scientific and technical problems of industrialisation, transport, communications and—not least—education. We've failed too often in Europe to look at our problems objectively, and it has been too easy to get excited about political differences when fundamentally our real needs were common ones which we could have solved in co-operation. I should not dare, as a scientist, to intervene in Indian political problems, and our own behaviour in Europe does not entitle a European to point at our own history as a very good example. It should, however, be possible to learn from failure and disaster and *our* failure has been too often that we have refused to recognise our common needs because of political differences. "Perhaps in India you'll be able to profit by our mistakes. One piece of advice, however, I'm confident in giving, namely, that it's worthwhile devoting a greater fraction of your national effort to scientific research and technical development: and I'd like to leave you with the three words—'one per cent.'"

SOUVENIR TO THE HON'BLE DEWAN BAHADUR SIR A. RAMASWAMI MUDALIAR, K.C.S.I.

SIR ARDESHIR DALAL, presenting the *Souvenir* to Sir A. Ramaswami Mudaliar on behalf of the Board of Scientific and Industrial Research, said that the Council of Scientific and Industrial Research owed its existence to the wisdom and foresight of Sir A. Ramaswami Mudaliar who alone realised, when others were urging the abolition of the Board, war was not the right occasion when scientific research should be cut down. It was just the time when it should be expanded. It was the last war that made England and America realise their backwardness in the matter of scientific and industrial research. England found that many of the materials necessary for the carrying out of the war she was incapable of producing and she was considerably handicapped in her fight against Germany which had a perfected scientific research organisation. It was in those circumstances that the Department of Scientific and Industrial Research had come into existence as separate organisation in England and America. In India at that time people did not realise the position and it required constant urging from scientific bodies all over the country and the sympathetic response of the Member of Government like Sir A. Ramaswami Mudaliar to bring the Board of Scientific and Industrial Research into existence.

It was too early, continued Sir Ardeshir to assess the work of the Board. Like all other newly founded bodies the Council had its troubles; it committed mistakes; but he did not believe that even the most unfriendly of critics could say that it had not already to its credit substantial achievements. For his part he said he was amazed at the wealth of scientific talent which the creation of the Body had brought forth and he made bold to say that given necessary facilities and opportunities there was nothing which scientists in India could not accomplish which others had done.

Sir Ardeshir next pointed out that the Council had enabled industrialists and scientists to come together. It had removed mutual misunderstandings between them. As a result the scientists no longer regarded the industrialists as mere exploiters who were interested in scientists to the extent they were useful to them in their efforts at "Dollar-making". The industrialists no longer regarded the scientists as mere theorists devoid of all practical touch with the realities of life. If scientific and industrial research had not made the progress that was expected of it, the main handicap was want of adequate resources. The Board was indebted to Sir Ramaswami Mudaliar for the grant of Rs. 10 lakhs which he had made the Government of India give to them. But Rs. 10 lakhs was a mere drop in the ocean and it bore no comparison to the huge amounts expended by England and America on scientific research. Even one crore would be not a great sum, in relation to the National wealth of India.

Replying, Sir Ramaswami Mudaliar said:—"Whatever may happen in the next few years, whatever political conditions we may or may not have, however much there may be suspicion between communities in this country, the force of time and the trend of events are such that industrial development in this country is an assured fact. Let there be no doubt about that. In the next three or five years there will be more industrial development than there has been in the past thirty years."

Thanking the Board for the beautiful *Souvenir* they had presented him with Sir Ramaswami Mudaliar said, "Coming as it did from eminent scientists and great industrialists in the country, he would treasure it as a priceless heirloom".

Proceeding Sir Ramaswami Mudaliar said that he had always felt that his contribution towards scientific effort was a drop in the ocean when compared with the generous contribution that had come from hundreds of scientists throughout the country. Theirs had been a most ample and generous response. But their talents had not been adequately recognised in

the past. There was no lack of scientific knowledge in this country and if the industrialists and scientists could be brought together and the latter realised the full value of scientific research, the industrial problem of India would be solved in no time.

Whatever might be the case with other countries, continued Sir Ramaswami Mudaliar, we must adapt ourselves to conditions in this country and it would be a most profitable mixture or amalgam to bring industrialists and scientists together in this Body and it was in that belief that this Body had been constituted. As a result of such co-operation he hoped that the Board of Scientific and Industrial Research would grow from shape to shape and from strength to strength.

He assured the members of the Board that his whole heart was with them and that he would continue to do what all he could for that Body to establish itself on a sound and permanent basis.

THE CENTENARY OF THE ROTHAMSTED EXPERIMENTAL STATION

THIS year the Rothamsted Experimental Station, which is the oldest agricultural experiment station in the world celebrated its hundredth anniversary. Most people have heard or read of the Rothamsted Experiment Station; many have either studied at the Station or visited it; but very few know of the history of the origin and development of this well-known agricultural experiment station which has done so much for the development of scientific agriculture.

Rothamsted is a village near Harpenden in Hertfordshire in England and belonged to John Bennet Lawes, a young English squire, who took great interest in farming. Lawes was born in the year 1814. His favourite hobby as a boy was experiments in chemistry. At the early age of twenty years, Lawes took into his hands the management of his farm at Rothamsted. One of the first things he did was to convert one of the barns into a chemical laboratory. With his close association with the farm and its crops Lawes soon became interested in the study of the growth of plants and began pot experiments with different crops and manures. He found that plants grew well in pots that received an application of animal charcoal, which was a waste product. He further found that plants grew even better if, before application, the animal charcoal was treated with sulphuric acid. Lawes had the vision to see a good business proposition in the results of these experiments and set up a factory for the treatment of animal charcoal, bones and phosphatic minerals, with sulphuric acid, and the production of super-phosphate. Thus were laid the foundations for the artificial fertiliser industry, which in subsequent years developed to enormous dimensions.

In 1840, Liebig enunciated his new theory of plant nutrition. Lawes carefully studied the principles underlying the theory. He had already his own ideas about plant nutrition and was, therefore, not convinced that Liebig's theory was entirely sound. He found that while the theory was sound in principle it was faulty in detail. He wanted to test it and correct it and for doing so, he required the help of a trained chemist. He engaged Joseph Henry Gilbert. The two worked together for nearly sixty years and laid the foundations not only of the Rothamsted Experiment Station but of agricultural science also.

It was in 1843 that Lawes and Gilbert laid at Rothamsted the first set of field experiments which were destined to become classical and which happily continue to this day. The Centenary of Rothamsted is thus really the centenary of these classical field experiment plots. The two young scientists could not possibly imagine then, that their experimental plots would be continued. If now they could come to life and visit their experimental plots at Rothamsted and the several hundreds of such plots since laid all over the world they would nod their warm approval with justifiable pride. Few partnerships in the field of science continued so long and with such fruitful results.

A few years before his death in 1900 Lawes established a trust under the name of Lawes Agricultural Trust and endowed it with £100,000 so that the great work which he initiated might be continued. He had the vision to realise that work must progress in consonance with the advance of science in the future and made the terms of the trust sufficiently wide to prevent unnecessary limitations. And what is more, he allowed for one hundred years the use of an area of over fifty acres for the continuance of his classical experiments.

After the death of Lawes in August 1900 A. D. Hall (later Sir Daniel Hall) became the first Director in 1902. Hall started his career as a lecturer on matters of interest to farmers, and before he became the Director of the Rothamsted Experimental Station was the Principal of the College of Agriculture at Wye. He collated the results of the experiments of Lawes and Gilbert, and wrote a book which is full of interesting and instructive tables besides a good deal of other useful information. Hall was succeeded by Dr. E. J. Russell (now Sir John Russell) as Director in the year 1912 and his retirement after thirty-one years as the Director coincides with the celebration of the Centenary. Dr. Ogg has now succeeded Dr. Russell as the Director of the Rothamsted Experimental Station.

When Lawes and Gilbert began their experiments chemistry appeared to be the only science that had a bearing on agriculture and for a long time that was the only science used at Rothamsted. Hall realised that chemistry and fertilisers were not the only ones that mattered and that other sciences were equally

important in agriculture and invoked the aid of botany, physics, microbiology, organic chemistry, entomology and plant pathology, in the study of problems concerned with soil conditions and plant growth. The development of biological research required mathematical methods for the sifting and evaluation of experimental data, and this need has been met by the addition of a section of statistics.

Since the time of director Hall and during the time of director Russell the Rothamsted Experimental Station marched from progress to progress and to-day the Station is well equipped for research on all problems in soil management and crop production. The work is carried out in a number of sections and subsections dealing with botany, soil physics, soil chemistry, microbiology, field experiments, statistics, crop physiology, insect pests, and plant diseases. The contributions of these different sections to the science and practice of agriculture are great and enduring.

The fields of work initiated at Rothamsted a hundred years ago by Lawes and Gilbert and subsequently developed by those that followed them are still yielding rich harvests. The founders started their programme of work on fundamental scientific problems. They did not base their programme of work to deal with the then problems of immediate practical importance even though that would have been justifiable in those difficult days called "the hungry forties" when more and cheap food was in great demand. Had they done so we would not have to-day the results which are so widely beneficial and permanent in value. Lawes and Gilbert laid emphasis on gaining knowledge as they had the vision and insight to realise that knowledge is essential for advance. The world to-day cannot be too grateful to these pioneers. Rothamsted celebrated its Centenary by extending the laboratories and facilities for scientific work and that is a fitting and enduring expression of gratitude to the great founders of the Rothamsted Experimental Station a hundred years ago.

B. VISWA NATH.

STUDIES ON THE PRESERVATION OF GLANDS

II. Preservation of Pituitary Glands

BY

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ADRENALINE AND THYROXINE are typical examples of hormones which can be isolated in pure crystalline condition and which can, therefore, be correctly dosed in the preparation of injectules. The posterior pituitary, on the other hand, is very often administered as a crude extract ('Pituitrin'), which is prepared by extracting the desiccated powder with 0·25 per cent. acetic acid and then distributed into ampoules after bioassay, such that each c.c. contains ten international units. Any decrease in the potency of the powder would necessitate more of powder to be extracted to give the same volume of solution: this would naturally involve the presence of more of extraneous protein in the final extract—which is highly undesirable. The study of the conditions for the proper collection and preservation of the pituitary glands is, therefore, of great significance.

Vitamin C is an important constituent of the pituitary glands (where it is present in greater concentration than in the adrenal glands) and a study of the changes in the vitamin content during collection and storage of the glands should give an insight into the stability of the glands. A detailed study was, therefore, undertaken of the vitamin C content of the glands collected and stored under different conditions: the methods used were firstly the titration method with the oxidation reduction indicator 2:6 dibromophenol-indophenol, and secondly, titration with standard iodine solution. As in the case of a previous study[1] on the preservation of adrenal glands, the iodine titration method was found to give consistently higher values than the indicator method, indicating the presence of extraneous reducing agents.

Tables 1 to 6 represent the figures for vitamin C (expressed as mg. of vitamin per g. of whole gland) obtained for the pituitary glands of cattle and sheep collected (1) in 'dry ice' (— 80°), (2) in freezing mixture (— 18°) and (3) melting ice (0°), soon after the animals were slaughtered and analysed within two to three hours (the time taken for transport of the glands from the abattoir to the laboratory).

Cattle Glands

TABLE 1 Collected in 'dry ice'		TABLE 2 Collected in freezing mixture	
Indicator	Iodine	Indicator	Iodine
1·43	1·68	1·38	1·71
1·41	1·67	1·36	1·78
1·45	1·72	1·31	1·68
Average 1·43	1·69	Average 1·35	1·72

Cattle Glands TABLE 3 Collected in ice		*Sheep Glands* TABLE 4 Collected in 'dry ice'	
Indicator	Iodine	Indicator	Iodine
1·29	1·55	1·72	2·04
1·30	1·60	1·70	2·01
1·31	1·59	1·84	2·18
Average 1·30	1·58	Average 1·75	2·08

Sheep Glands

TABLE 5
Collected in freezing mixture

Indicator	Iodine
1·72	2·12
1·68	2·05
—	—
Average 1·70	2·09

TABLE 6
Collected in ice

Indicator	Iodine
1·65	1·95
1·66	2·06
1·58	1·85
Average 1·63	1·95

Tables 7 to 10 represent the vitamin C contents of cattle glands which were transported to the laboratory in melting ice and subsequently stored for varying periods at the Frigidaire temperature of 0 to 5°, with the addition of toluene as preservative.

TABLE 7
Glands stored overnight at 0°

Indicator	Iodine
1·16	1·37
1·19	1·43
1·14	1·41
Average 1·16	1·40

TABLE 8
Glands stored for two days at 0°

Indicator	Iodine
0·90	1·08
0·91	1·11
0·91	1·04
Average 0·91	1·08

TABLE 9
Glands stored for three days at 0°

Indicator	Iodine
0·70	0·86
0·71	0·87
0·69	0·86
Average 0·70	0·86

TABLE 10
Glands stored for four days at 0°
(putrefaction sets in)

Indicator	Iodine
0·43	0·59
0·39	0·47
0·34	0·50
Average 0·39	0·52

Tables 11 to 16 represent the changes in the ascorbic acid content of cattle glands, which were brought to the laboratory packed in ice and stored frozen for varying periods at − 7° C. (in the freezing chamber of a frigidaire) with the addition of a few drops of toluene as preservative (except Table 11, where the glands were transported to the laboratory in dry ice).

TABLE 11
Glands brought in 'dry ice' and stored overnight in 'dry ice'

Indicator	Iodine
1·33	1·62
1·36	1·63
1·35	1·58
Average 1·35	1·61

TABLE 12
Glands stored overnight at − 7°

Indicator	Iodine
1·30	1·62
1·26	1·62
1·24	1·58
Average 1·27	1·61

TABLE 13
Glands stored for three days at − 7°

Indicator	Iodine
1·27	1·60
1·26	1·58
Average 1·27	1·59

TABLE 14
Glands stored for one week at − 7°

Indicator	Iodine
1·18	1·49
1·15	1·39
1·13	1·48
Average 1·15	1·45

TABLE 15
Glands stored for two weeks at − 7°

Indicator	Iodine
1·12	1·43
1·11	1·41
1·16	1·46
Average 1·13	1·43

TABLE 16
Glands stored for four weeks at − 7°

Indicator	Iodine
1·02	1·23
1·00	1·21
0·99	1·19
Average 1·00	1·21

It will be clear from the above tables that the ideal way of collection of the glands would be to freeze them immediately after removal from the carcass, either with freezing mixture or preferably with solid carbon-dioxide. As regards the storage of glands, rapid decomposition of the vitamin is observed when the glands are stored at 0-5°: at the end of two days over 25 per cent. of the vitamin is lost and on the fourth day the vitamin content is only a third of the original amount. The glands can, however, be kept frozen for several weeks, without any physical deterioration, in which state it can be conveniently transported to distant places. At the end of three days the decomposition of vitamin C in the frozen glands is only 10 per cent. and even after two weeks the loss in the vitamin is only about 20 per cent.

It has often been pointed out that freezing of glands and subsequent thawing is accompanied by rapid destruction of the active principles due to the mechanical rupture of the cell structure (*cf.* Mills).[2] In the course of our analyses of frozen pituitary glands it was repeatedly observed that thawing of frozen glands (which was effected by contact with cooled water) was accompanied with rapid destruction of the vitamin, unless the glands were immediately assayed for the vitamin content. The following tables (17, 18 and 19) represent three typical sets of results obtained on analysis of the vitamin content of frozen glands (the freezing being effected with dry ice, freezing mixture and keeping in freezing chamber at − 7), the entire batch of glands being thawed in one lot and the extraction being spread over 30 to 60 minutes.

TABLE 17

Thawing of glands frozen with dry ice

Indicator	Iodine
1·43	1·68
1·28	1·55
1·23	1·45

TABLE 18

Thawing of glands frozen in freezing mixture

Indicator	Iodine
1·26	1·75
1·08	1·47
1·00	1·27

TABLE 19

Thawing of glands kept in freezing chamber

Indicator	Iodine
1·03	1·35
0·87	1·21
0·72	1·04

It is advisable, therefore, to process the thawed glands without undue delay for the isolation of the active principles.

The following tables (Nos. 20 and 21) represent the distribution of vitamin C in the anterior and the posterior lobes of the pituitary glands of cattle and sheep, the analyses being carried out on fresh glands transported to the laboratory, packed in dry ice.

TABLE 20

The distribution of vitamin C in the cattle pituitary

Anterior lobe		Posterior lobe	
Indicator	Iodine	Indicator	Iodine
1·47	1·90	0·82	1·23
1·49	1·95	0·79	1·30

TABLE 21

The distribution of vitamin C in the sheep pituitary

Anterior lobe		Posterior lobe	
Indicator	Iodine	Indicator	Iodine
1·50	1·82	0·56	1·12
1·56	1·83	0·54	1·05

Vitamin C is thus present in higher concentration in the anterior lobe than in the posterior—an observation in conformity with the findings of Phillips and Stare.[3]

The expenses of this investigation were met entirely by the Board of Scientific and Industrial Research, to whom our grateful thanks are due.

1. Dey, Krishnan and Srinivasan, *Curr. Sci.*, 1943, **12**, 244. 2. Mills, *Biochem. J.*, 1932, **26**, 704. 3. Phillips and Stare, *J. Biol. Chem.*, 1934, **104**, 351.

DR. C. W. B. NORMAND, M.A., D.Sc., C.I.E.

WE learn with great pleasure of the award of the Symons Gold Medal of the Royal Meteorological Society to Dr. C. W. B. Normand, Director-General of Observatories, India.

Awarded for outstanding work in meteorology, the Symons Medal is among the highest honours that a worker in meteorology in Great Britain or abroad can aspire to. The honour is conferred upon distinguished meteorologists of world-wide reputation every two years, alternately for work in Great Britain and abroad. Dr. Normand has received the medal for his work in India; but, nevertheless, his most outstanding work, *viz.*, on the thermodynamics of the wet-bulb thermometer, has universal application to the atmosphere over all regions.

Dr. Normand, a distinguished student of physical chemistry of the Edinburgh University, has been a member of the Indian Meteorological Service since 1913, and for the last sixteen years the Head of the Indian Meteoroloical Department. Ever since he joined the Department his work has been in meteorology, and his deep understanding of thermodynamics has been of particular service to him in tackling some of the complicated problems of stability and instability of the atmosphere. He has devoted considerable thought and hard work for years to his favourite problems. He has not yet made public all the results of his investigations, but the quality of the work he has so far published has already earned international recognition and also the high honour that the Royal Meteoroloical Society has now conferred on him for which we offer him our congratulations.

We may here recall the names of some of the renowned meteorologists of the world who have been the previous recipients of the Symons Medal: Among others they have been Sir Napier Shaw, Hann, Hildebrandsson, Bjerknes, Hergessel, Schmidt, W. H. Dines Sir G. C. Simpson, Sir G. T. Walker and Lt.-Col. Ernest Gold.

LETTERS TO THE EDITOR

QUASI-LATIN SQUARES IN EXPERIMENTAL ARRANGEMENTS

IN the thesis submitted by the author in 1943 to the Calcutta University, it was shown how the Design of Experiments consists of the Fundamental problem together with the problem of Balancing and the Construction of designs. Every experimental design is a mathematical solution to a combinatorial problem directly deducible from the mathematical model set up by the necessary balance and other requirements such as the block size, number of replications, cost of experimentation, etc., required by the experimenter. Two types of designs called as 'The partially balanced design' and 'The Intra- and Inter-group balanced design', gave a variety of designs in the case of incomplete block designs. These two systems, also, gave balanced or partially balanced confounded designs in the case of general factorial experiments, asymmetrical or symmetrical. It is proposed to extend these ideas to Quasi-Latin squares which are suggested by Fisher's requirement of the 'local control' by which the efficiency of an experimental design may be enhanced by minimising the error without increasing the number of replications. These were first introduced by Yates[1] in the case of incomplete block designs.

The Fundamental Problem.—The most general set up consists of v treatments denoted by $T_1, T_2, T_3 \ldots T_v$ tested in n lattice square arrangements of s^2 cells each, such that the i-th treatment is replicated r_i times and the treatments T_i and T_j appear together in columns and rows combined λ_{ij} times and in squares, on the total μ_{ij} times. The parameters are connected by the following relationships:—

$$\lambda_{ii}=0$$

$$\lambda_{ij}=\lambda_{ji};\ \mu_{ij}=\mu_{ji}$$

$$\Sigma\, r_i=n\, s^2$$

$$2\ (s-1)\ r_i=\sum_j \lambda_{ij}$$

$$r_i\ (s^2-1)=\sum_j \mu_{ij}$$

Analysis of the General Design.—Using the methods of analysis developed in the above thesis we get the estimating equation as,

$$Q_i=r_i\ (s-1)^2\, t_i-s\sum_j \lambda_{ij}\, t_j+\Sigma\, \mu_{ij}\, t_j$$

where t_i estimates the effect of the treatment T_i, and

$Q_i = s^2$ (sum of observations of the i-th treatment)
— s (sum of row and column totals in which the i-th treatment occurs)
+ the weighted sum of square totals the weights being number of times the i-th treatment occurs in a square.

From these set of equations, we can test the significance of any estimable linear expression of the treatment effects by comparing it against its estimated standard error. The estimates of linear expressions being linear functions of Q_i, their standard errors, ultimately, depend on the following results. Let Q_i be gathered from m_i lattice squares the contribution from the j-th square being q_{ij}.

$$Q_i=\Sigma\, q_{ij}$$

$$V\ (Q_i)=\sum_j V\ (q_{ij})$$

$$V\ (q_{ij})=r\ (s-2\ s+r)^2+(s-r)^3\ 2r+(s-r)^2 + r\ (r-1)\ (r-2s),^2$$

when the i-th treatment occurs r times in j-th lattice square.

Cov $(Q_i Q_m) = \Sigma$ Cov $(q_{ij} q_{mj})$.

The most general expression for the covariance has been found out but is not given here due to lack of space. There are two types of designs which appear to be fruitful.

Type 1.—Let $s\lambda_{ij} - \mu_{ij} = v_{ij}$. We impose restrictions on v_{ij} similar to that of the partially balanced design (it may be noted that the second system of parameters introduced by Bose and Nair[2] are restrictions on the parameters v_{ij}) or the Intra- and Inter-group balanced design of the incomplete blocks. Thus we get two subtypes in type 1.

Type 2.—$\mu_{ij} = \mu$ $i \neq j$, independently of i and j. In this case we impose restrictions on the parameters λ_{ij}. We get two subtypes by allowing the parameters to satisfy the conditions of the partially balanced or the Intra- and Inter-group balanced design of the incomplete block designs.

Various methods of construction of the designs such as the geometrical and the method of differences developed by Bose[3] and used by the author have been found out and a full list of practically useful designs will be given in an elaborate paper to be published shortly. Also the Quasi-Latin squares used for double confounding in factorial experiments, the necessary and the sufficient condition for which has been given by the author in the work referred to, come out as special cases.

Statistical Laboratory,
Calcutta, C. RADHAKRISHNA RAO.
October 4, 1943.

1. Yates, *Technical Communication* 35, *Imp. Bureau Soil Science*. 2. Bose and Nair, *Sankhya*, **4**, 337–72. 3. —, *Ann. of Eugen*, **9**, 358–99.

CATALYSIS OF THE INTERACTION BETWEEN HYDROGEN SULPHIDE AND SULPHUR DIOXIDE BY SILVER SULPHIDE

IN the course of an investigation on the influence of moisture on the interaction between hydrogen sulphide and sulphur dioxide ($2\ H_2S + SO_2 \rightarrow 2\ H_2O + 3\ S$), it was noticed that the reaction between the two gases occurred only to a small extent at the surface of pure silver powder but that the reaction was highly autocatalytic, owing to the production of silver sulphide, which vigorously catalysed the union. For instance, in a representative experiment where the volume of the gases was kept constant (the reaction vessel being in an air thermostat at 32°·5 C.) the fall in pressure due to interaction at the surface of silver was only 13 mm. during the first 70 minutes and the silver gradually acquired a dark colour, owing to the formation of silver sulphide. During the next 20 minutes, however, owing to the catalytic effect of silver sulphide, the fall in pressure was 103 mm.

The progressive formation of water during the above reaction greatly enhanced the autocatalytic nature of the reaction, the activity of silver sulphide being proportional to the vapour pressure of water in the system. Using a hygrostat (mixture of suitable hydrate and its anhydrous form, *e.g.*, oxalic acid, barium bromide) the vapour pressure of water in the reaction vessel could be controlled and the effect of moisture on the catalytic activity of silver sulphide studied. When phosphorus pentoxide was used as the desiccant, the silver sulphide was inactive.

To catalyse the union of the two gases at the surface of glass, a very much higher vapour pressure of water was found to be necessary, than in the case of silver sulphide. The kinetics of the reaction between sulphur dioxide and hydrogen sulphide, as catalysed by silver sulphide could, therefore, be conveniently investigated in a glass apparatus, wherein the vapour pressure was kept sufficiently low with the aid of an appropriate hygrostat, so that while no detectable reaction took place at the surface of glass, the catalytic activity of silver sulphide was adequate.

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October 6, 1943.

CATALYTIC ACTIVITY OF SILVER SULPHIDE

SILVER SULPHIDE, which had been found by one of us to catalyse the union between hydrogen sulphide and sulphur dioxide, was noticed to have an equally remarkable catalytic effect on the decomposition of sulphur monoxide (and its polymer S_2O_2). The monoxide, prepared by the combustion of sulphur in carefully dried oxygen under a pressure of 5 mm. of mercury, was passed over silver sulphide and found to undergo rapid decomposition as indicated by the increase in weight of the sulphide, due to sulphur deposition. In one series of experiments, wherein the same sample of silver sulphide was used as catalyst, the sulphur produced by decomposition of the monoxide was 30·5, 22·4 and 20·0 mg., the corresponding volumes of oxygen employed in the combustion of sulphur being 195, 210 and 250 c.c. A noticeable fall in efficiency of the sulphide occurred as the catalyst got covered by sulphur. In another experiment, when a fresh sample of catalyst was used, the weight of sulphur deposited was 265 mg. when 4 litres of oxygen were employed for combustion.

Silver sulphide was also found to rapidly catalyse the reaction between hydrogen sulphide and sulphur monoxide, even when both the gases had been carefully dried over phosphorus pentoxide. As in the previous experiments, the sulphur liberated during the reaction, was determined by measuring the increase in weight of the silver sulphide. Water formed, was absorbed in a phosphorus pentoxide tube and weighed. As was to be expected, two reactions took place simultaneously at the surface of the catalyst—the decomposition of sulphur monoxide and the reaction between hydrogen sulphide and sulphur

monoxide in terms of the equation $SO + H_2S = 2S + H_2O$. It was not practicable to suppress completely the decomposition of sulphur monoxide at the surface of silver sulphide, but by increasing the proportion of hydrogen sulphide to that of oxygen* used in the combustion of sulphur, the extent of the interaction between hydrogen sulphide and sulphur monoxide could be increased, as could be gathered from results obtained in a set of experiments:—

Ratio H_2S/O_2	Wt. S in mg.	Wt. H_2O in mg.	Ratio S/H_2O
1·0	32·0	5·0	6·4
1·6	19·0	4·2	4·5
4·0	11·5	3·0	3·8

If the interaction between hydrogen sulphide and sulphur monoxide was the only reaction taking place at the catalyst surface, the ratio of sulphur to water would be 3·6. It has to be noted that the sulphur dioxide produced along with the monoxide during the combustion of sulphur, does not react with hydrogen sulphide at the surface of silver sulphide when phosphorus pentoxide is used as the desiccant for the two gases. Further work is in progress.

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October 6, 1943.

*No accurate method that can conveniently be employed, is at present available for the determination of sulphur monoxide in the products of combustion. Conditions under which the sulphur was burnt were kept as constant as possible, and it was assumed that the sulphur monoxide produced was directly proportional to oxygen used in combustion. A method for the accurate determination of sulphur monoxide, based on its catalytic decomposition by silver sulphide, is now being developed in this laboratory.

A SENSITIVE METHOD FOR THE ESTIMATION OF COMMON VOLATILE TRIHALOGEN ANÆSTHETICS IN THE BLOOD AND TISSUES OF ANIMALS

FUJIWARA[1] in 1914 found that chloroform in the presence of alkali gives a pink colour with pyridine and that the method can detect chloroform in dilutions upto 1 in a million. Cole,[2] in 1926, utilised this method for determining the concentration of chloroform in the body tissues. Recently Daroga[3] *et al.* have stabilised the colour produced by adding a little acetone. All these applications of Fujiwara reaction suffer from a drawback that the colour obtained is not quite clear due to the presence of protein in tissues and blood and that the colour of the blood interferes with the estimations. The present work is concerned with a new method where the Fujiwara reaction has been employed to detect and estimate the common trihalogen volatile anæsthetics in the blood and other body tissues.

METHOD

5 c.c. of blood from an animal anæsthetised with chloroform or trichlorethylene are put in a 1½" diameter test tube containing 40 c.c. of distilled water and 5 c.c. of 0·05 per cent. saponin solution. The test-tube is fitted with a rubber cork through which pass two tubes, one as an entry for air and the other as an exit for it. The exit is bent twice at right angles and passed into another rubber cork with a condenser arrangement fitting to a similar test tube and containing 20 c.c. of pyridine. The exit tube dips into pyridine. The pyridine test tube is immersed in ice and ice water is circulated in the condenser which is fitted to it. The condenser exit is passed through rectified spirit which acts as a trap. Care is taken to see that all the connections are air-tight except the last exit. The blood is now air-distilled and the quantity of chloroform or trichlorethylene present in the blood is absorbed in pyridine. The current of air is passed for one and half hours and after this period the test tube containing the hæmolysed blood is heated to about 80° C. by gentle heat, while the current of air is continued. After 2½ hours the apparatus is disconnected. The trap of rectified spirit is always tested for the presence of the anæsthetic. It is found that as long as the pyridine test tube and the condenser are properly cooled no anæsthetic could be detected in the trap. The pyridine in the test tube which now contains chloroform or trichlorethylene is taken for qualitative and quantitative estimations.

The pyridine containing the anæsthetic is diluted 1 in 4 with fresh pyridine. 5 c.c. of this solution are transferred to a long test tube containing 10 c.c. of 20 per cent. alkali [NaOH] and then lightly plugged with cotton wool. The test tube is now dipped into a boiling water bath for 1½ minutes and then cooled in ice. The coloured pyridine layer is transferred to another test tube and compared in a Leitz colorimeter with the colour produced by a standard solution of the anæsthetic prepared in pyridine. The concentration of the standard is usually 1·2 mg./100 c.c. The colour is stable for half an hour after removal if it is kept cold and no acid vapours are allowed to come in contact with it.

For estimating the anæsthetic in tissues, the tissue is finely minced and ground in a mortar and pestle, the whole operation being performed under acidified ice-cold water. The acid-water along with the suspended tissue is then transferred to a wide test tube and the procedure described above followed.

The method was standardised by estimating a known quantity of chloroform or trichlorethylene added to the blood. The following table shows some of the results obtained and the percentage variation between the actual quantities added and those that are estimated.

With this method the concentrations of chloroform in the blood of various animals

No.	Name of Anæsthetic	Quantity added	Quantity estimated	Variation per cent.
1	Trichlorethylene	1·4 mg./ 200 c.c.	1·25 mg./ 200 c.c.	−0·075 mg./ 100 c.c.
2	Chloroform	1·125 mg./ 100 c.c.	1·325 mg./ 100 c.c.	+0·20 mg./ 100 c.c.

were determined and it was found that in all these cases the results obtained which will be published later are in close agreement with the recent findings of other workers.

My thanks are due to Dr. B. B. Dikshit for his keen interest in the work. My thanks are also due to Lt.-Col. Sokhey, I.M.S., Director, Haffkine Institute, for the facilities given for carrying out the work.

Pharmacological Dept.,
Haffkine Institute,
Bombay,
October 14, 1943.

R. N. Kulkarni.

1. Fujiwara, *Sitzmgsb u. Abhandl., Naturfors*, 1914, **6**, *l. Ges. Rostock. Chem. Abs.*, 1917, **11**, 3201. 2. Cole, *J. Bio. Chem.*, 1926, **71**, 173. 3. Daroga & Pollard, *J. Soc. Chem. Ind.*, 1941, **60**, 218.

PANICUM MILIACEUM (GUJARATI-CHENA), A NEW RAW MATERIAL FOR STARCH INDUSTRY

The fall in the imports of starch into India, and the increased demand for sizing agents for the textile industry, have rendered the search for a suitable indigenous source of starch both urgent and necessary. In view of the prevailing food scarcity, cereals like wheat, maize and jawar are no longer available for industrial purposes. Attempts to utilise, for the first time, the corn *Panicum miliaceum*, which is grown in Gujarat as a side crop during both the rainy and hot seasons, have proved eminently successful. The normal yield of this crop is 20 maunds per acre. The stems and roots of this corn are used as manure. The straw provides excellent fodder in considerable quantity when there is scarcity of fodder. The following is the chemical composition of the grain:—

Moisture 7·8 per cent., Ash 4·95 per cent., Fibre 9·75 per cent., Fat 4·0 per cent., Protein 9·06 per cent., Carbohydrates 64·44 per cent.

The usual treatment of corn, *i.e.*, steeping, milling, caustic treatment and tabling, yields 52 per cent. of pure starch. The starch in microscopic appearance resembles maize starch and possesses the following properties, to recommend its use as a sizing agent in the textile industry:—

The gelatinisation temperature is 76° C.

The following table gives a comparative idea of the viscosity in relation to maize and wheat.

Effect of continued heating at 90° C. on change in viscosity.

(In 1/5 seconds) (By Stormer Viscometer)

3% Starch paste	10 Mts.	15 Mts.	20 Mts.	25 Mts.	30 Mts.	60 Mts.	120 Mts.	180 Mts.	240 Mts.	360 Mts.
Maize ..	57	52	51	51	51	49	45	41	39	37
Wheat .	45	46	46	43	43	39	37	36	35	34
Panicum miliaceum (Chena) ..	37	40	—	41	44	49	54	50	48	40

On large-scale sizing test carried out in textile mill, the results of this starch have been found to be identical to that of the maize starch.

Further, the waste bran obtained after separation of starch from the corn contains 11·4 per cent. protein matter which compares favourably good with other cattle-feeds.

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October 15, 1943.

C. B. Patel.

N[1]-SULPHANILYL-ISOTHIOUREAS

Although the preparation of many N[1]-sulphanilyl-derivatives of urea, thiourea, guanidine, etc., has been described, there appears to be no systematic study of N[1]-sulphanilyl-isothiourea derivatives reported in literature. As these bear structural resemblance to sulphathiazole the following derivatives

(I) acetylaminobenzenesulphonyl-ethylisothiourea, m.p. 180-1°;
(II) acetylaminobenzenesulphonyl-propylisothiourea, m.p. 174°;
(III) acetylaminobenzenesulphonyl-butylisothiourea, m.p. 157°;
(IV) acetylaminobenzenesulphonyl-allylisothiourea, m.p. 173–74°; and
(V) acetylaminobenzenesulphonyl-benzylisothiourea, m.p. 171–73°;

have now been prepared from the corresponding alkyl isothiourea hydrochlorides and hydrobromides using standard methods.

The free bases corresponding to compounds (I) to (IV) are obtained by digestion with 8-10 per cent. aqueous hydrochloric acid for 15-20 minutes, and they melt respectively at 155-56°, 133-34°, 116° and 170°. Roblin *et al.*[1] prepared the free base of the compound (I) by hydrolysing it with alcoholic hydrochloric acid for two minutes. It has now been found that the hydrolysis of the compounds (I) to (IV) is not carried to completion by this method. Hydrolysis of the compound (V) by the above methods is attended with disruption of the molecule, yielding only sulphanilic acid and benzylmercaptan. Further work on the condensation of other isothiourea hydrobromides

with *p*-acetylaminobenzenesulphochloride is in progress.

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Organic Chemistry Laboratory,
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Bangalore,
November 6, 1943.

1. Roblin, *et al.*, *J. Amer. Chem. Soc.*, 1942, **64**, 1682.

THE ROLE OF TRYPTOPHANE IN BLOOD FORMATION

On purely chemical grounds the essential function of tryptophane in the animal organism has been considered to be that of providing the pyrrole ring for the synthesis of hematin. But the experiments designed to throw light on the relation of this amino-acid to blood formation have yielded contradictory results. The beneficial effect of tryptophane injections in experimental anæmia in animals has been reported by Hirasawa (1921),[1] Okagawa and Tatsui (1931)[2] and by Iwakura, Otani and Taniguchi (1933).[3] Fontès and Thivolle (1930)[4] claim to have produced anæmia in rats by feeding them on tryptophane-deficient diets and to have rendered normal animals hyperemic by injection of tryptophane or a tryptophane histidine mixture. Alcock (1933)[5] was, however, unable to confirm either of these observations of the French authors. Hæmoglobin regeneration in animals suffering from milk anæmia was found by Alcock to be unaffected by administration of tryptophane, nor could he render animals anæmic by depriving them of the amino-acid. From determinations of the tryptophane and histidine content of the blood of patients suffering from pernicious and hæmorrhagic anæmia Tochowicz (1936)[6] similarly concluded that these amino-acids play no important part in blood formation.

In the experiments now reported the effect of tryptophane deficiency in the diet was studied in the first place on normal rats and secondly on rats made anæmic by means of phenylhydrazine injections.

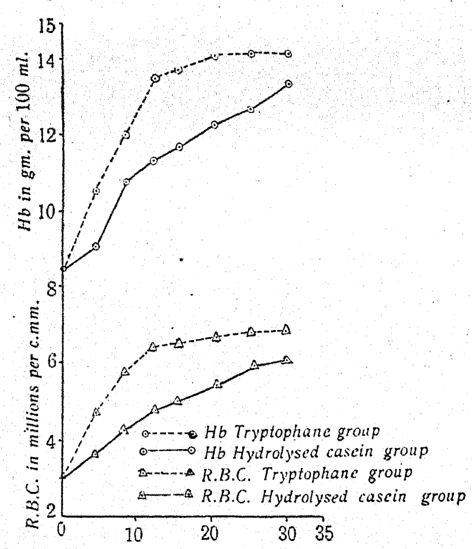
The experimental diet consisted of the following:—Casein (whole or hydrolysed), starch, sugar, butter fat and Steenbock's salt mixture. The vitamins were supplied in the form of yeast and cod-liver oil. Hydrolysed casein provided the tryptophane-deficient diet.

In experiments on normal rats three groups were used, group I receiving whole casein, group II hydrolysed casein plus 20 mg. of tryptophane per rat per day, and group III hydrolysed casein.

R.B.C. determinations were made at the beginning and at the end of the experiment which lasted one month. The average values for R.B.C. in each group are given in Table I, from which it will be seen that the values are slightly lower for animals receiving no tryptophane in the diet than those on the whole casein or hydrolysed casein plus tryptophane. This slight difference was repeatedly found in different series of experiments, but the results are not statistically significant.

However, striking differences due to the absence of tryptophane in the diet were found when animals were first made anæmic by phenylhydrazine as described previously (Yeshoda, 1942).[7]

The results of one experiment on two groups of eight such animals, one receiving hydrolysed casein, the other hydrolysed casein plus tryptophane are summarized in Table II which gives the average increases for R.B.C. and hæmoglobin in each group in twelve days after the stage of acute anæmia. Statistical examination of the values for individual animals in the two groups show the results to be highly significant. Curve I shows clearly the differences in the rates of recovery of the animals in the two groups. While the animals receiving tryptophane had regained their normal R.B.C. values in twelve days and their normal hæmoglobin values in fifteen days, the corresponding periods for the rats in the tryptophane deficient group were about thirty days, and even then the values for both R.B.C. and hæmoglobin were slightly below normal.



There can be no doubt from these experiments that tryptophane plays an important

Table I

	Casein			Hydrolysed casein + tryptophane			Hydrolysed casein		
	Days		Increase	Days		Increase	Days		Increase
	0	30		0	30		0	30	
R.B.C. in millions per c.mm.	7·06	8·03	·97	7·12	8·03	·91	6·97	7·49	·52

role in blood regeneration. It is true that, as in Alcock's experiments, in normal animals tryptophane deficiency produces no marked anæmia, but this must be explained on the assumption that blood composition is maintained constant by utilization of tryptophane derived from tissue wastage as is proved by the fact that although animals on a tryptophane-deficient diet present a nearly normal blood picture, they loose weight continuously during the experimental period.

TABLE II

	Hydrolysed casein + tryptophane			Hydrolysed casein		
	Days		% Increase	Days		% Increase
	0	12		0	12	
R.B.C. in millions per c.mm.	3·04	6·45	112·1	3·06	4·75	55·24
Hæmoglobin in gm. per 100 mm.	8·34	13·7	63·52	8·39	11·77	40·28

	R.B.C.	Hæmoglobin
Standard error of difference	17·9	6·77
Value of t	4·66	11·95

The author's thanks are due to Prof. M. Damodaran for his valuable help and interest in the work, and to Dr. N. Sundararama Sastri for the statistical analysis of the results.

University Biochemical Laboratory, Madras, K. M. YESHODA.
November 8, 1943.

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THE INDUCED OXIDATION OF OXALIC ACID BY DICHROMATE WITH FERROUS SULPHATE AS INDUCTOR

DURING the course of some other work we discovered that the presence of oxalate interferes with the titration of ferrous sulphate with dichromate by giving rise to a consumption of dichromate far in excess of the amount required for the oxidation of the ferrous iron present. This excess consumption of dichromate cannot be explained as due to any primary reaction between oxalate and dichromate, for it is known from the work of Dhar[1] that oxalic acid is only slowly oxidised by dichromate at ordinary temperatures. Further, we have observed that, in the absence of ferrous sulphate, oxalate at the concentrations employed in our experiments does not consume any dichromate, the deep blue colour indicative of the end point with the diphenyl amine reagent being produced by the addition of a single drop of dichromate. Detailed experiments carried out by us have led to the conclusion that the observed interference of oxalate is due to the fact that the rapid reaction between ferrous sulphate and dichromate induces the reaction between oxalate and dichromate.

The following table incorporates some of the typical results:—

10 c.c. N/20 Fe SO_4 + 5 c.c. 4N H_2SO_4 + 2·5 c.c. H_3PO_4 (1·75 Spgr) + 0·5 c.c. 0·1% diphenylamine + X c.c. oxalate + water to make up the volume to 50 c.c.

Concentration of oxalate	Amount of dichromate 0·0529 N (in c.c.)	Induction factor (F) $F = \frac{\text{No. of moles of oxalate oxidised}}{\text{No. of moles of } FeSO_4 \text{ oxidised}}$
Nil	9·45	
0·01N	12·05	0·14
0·03N	14·15	0·25
0·05N	14·80	0·28

From the results given in the above table, it will be seen that the induction factor increases with increasing concentration of oxalate the concentration of ferrous sulphate and hydrogen ion being kept constant.

We have also found that ferrous sulphate induces the reaction between dichromate and tartaric, citric, and malic acids but not succinic acid.

Andhra University, C. R. VISWANADHAM.
November 17, 1943. G. GOPALA RAO.

1. Dhar, N. R., *Trans. Chem. Soc.*, 1917, **111**, 707.

AN IMPROVED METHOD OF LOCATING TANNINS IN PLANT SECTIONS

COMMON TESTS FOR TANNINS

VARIOUS methods[1] have been described for locating tannins in plant tissues, but they all suffer from one disadvantage or the other. Vinson[2] fixes and stains tannins *in situ* by exposing whole organs to vapour of amyl or ethyl nitrite. He recommends a 20 per cent. alcoholic solution of ethyl nitrite, but, owing to its low boiling point (16° C.) it volatilizes so rapidly at the temperatures prevailing in this country, that in practice it becomes difficult to get satisfactory results. Amyl nitrite on the other hand though less volatile, is disagreeable to use.

Methylene blue (1:500,000) followed by saturated aqueous picric acid, has also been

recommended for staining tannins in the living state[3] but the test is not very specific as other tissues besides tannins are also stained.

One of the most commonly used methods for detecting tannins in plant sections is to draw a drop of 10 per cent. ferric chloride under the cover glass by means of filter paper.[4] The tannins are stained dark green, blue or black. The method is very useful especially when there is a high accumulation of tannins as in galls or near wounds or infected tissue. But as the test is not very sensitive it cannot be successfully used when the concentration of tannin in the tissues is very low (1-10 p.p.m.).

Recently Dastur[5] has prepared standard slides of sections of cotton leaves, showing different degrees and extent of tannin accumulation, but unfortunately he has not described the technique employed.

Advantages of Folin Denis Reagent (F.D.R.)

The author while working on the causes of discolouration of jute during retting tried the above methods for locating the tannins in the stem sections but without any success. It was then, that the idea of using Folin Denis Reagent suggested itself. F.D.R. has previously been used with a great amount of success as delicate test for microquantities of tannins as 1 p.p.m.[-6]; but the possibility of its being used as a new stain in histological work has never been explored. The author after repeated trials has been able to develop a standard technique by which F.D.R. can successfully be used as a delicate and reproducible test for locating the tannins in plant sections.

The method is simple and presents great advantages over those described before. In the first place it is very specific, no other tissues besides those containing tannins being stained. In order to verify its specific nature, sections of different plant materials were separately stained with standard lignin and cellulose stains, *viz.*, phloroglucin, Maule, anilin sulphate, Schultze's solutions, iodine followed by sulphuric acid and also F.D.R., and examined under the microscope. It was found that tissues which gave a positive reaction either for lignin or for cellulose were in many cases not stained by F.D.R. For instance the xylem or wood though mostly lignified was not stained blue with F.D.R.; so also the pith and rays which are predominantly cellulosic in character, showing thereby that F.D.R. is neither a lignin nor a cellulose stain. Cellulose and lignified tissues are stained by F.D.R. only in the presence of tannin. Thus cotton fibres and filter-paper pulp do not show any colour when stained with F.D.R. but the same materials when treated with F.D.R. after a preliminary steeping in tannin (10 p.p.m.) give a distinct blue colouration.

The method is also more sensitive than any of those described earlier and can be used with very good results even when the concentration of tannins in the tissues is as low as 1 p.p.m. Staining is also permanent. It has been successfully tried for number of plants like flax, tea, jute, etc., and is described below.

The F.D.R. Method for Detecting Tannins in Plant Section

Preparation of reagents.—Only two solutions are required and they are prepared as follows:—

A. 2·25 gms. of phosphotungstic acid, 0·5 gm. of phosphomolybdic acid and 1·5 c.c. of syrupy phosphoric acid are taken in a small conical flask to which are then added 17·5 c.c. of distilled water. The mixture is boiled over a water-bath under reflux for two hours, allowed to cool and then made up to 25 c.c. by adding the required quanitity of distilled water. The solution deteriorates on exposure to strong light, and it is advisable to keep it in an amber coloured bottle preferably wrapped in black paper.

B. A saturated aqueous solution of sodium carbonate is prepared by boiling 70-75 gms. of anhydrous sodium carbonate with 100 c.c. of distilled water till dissolved. The solution is allowed to cool and settle down and the clear liquid from the top is then decanted and if necessary filtered before use.

Procedure.—As the stain is aqueous the sections have to be brought down to distilled water before applying the stain. The sections are covered with just sufficient quantity of solution A for about 15-30 minutes though with fresh green sections even 5 minutes were found to be quite sufficient. The solution is then drained off and the sections neutralized with a few drops of solution B. The staining is complete when the effervescence due to escape of carbon dioxide ceases. A blue colour is obtained with the formation of a cloudy white precipitate. No attempt should be made to remove the white precipitate by washing the sections in water as the blue stain is readily soluble in water. As soon as neutralization is effected the sections are quickly passed through 30, 50, 70, 85, 95 per cent. and absolute alcohol, cleared in xylol and mounted in balsam. Tissues containing tannins are stained a deep, steel-blue. The staining is permanent and the preparations keep well.

Material Studied

The author has tried the method with uniformly good results for a number of plants. In jute, only the fibre bundles of the phloem are stained the tannins being located in the cell walls, contrary to the findings of Nodder.[7] According to Kundu,[8] in jute, the dark deposits which occur abundantly in the cortex and rays are tannins, but they do not take any stain with F.D.R. which clearly shows that they are not tannins. Their chemical nature, however, appears to be in doubt.

A list of plant materials where the presence of tannins has been demonstrated by the above method is given below.

Stem.—*Corchorus capsularis*, *C. olitorius*, *Hibiscus sabdariffa*, *H. rosasinensis*, *H. esculentus*, *Crotalaria juncea*, *Linum usitatissimum*, *Cajanus indicus*, *Mangifera indica*, *Ricinus communis* Rosa sp.

Twigs.—*Camellia Thea*, *Gossypium* sp., *Sesbania grandiflora*.

LEAVES.—*Agave sisalana Bromelia* sp.
FRUIT.—*Musa* sp., *Gossypium* sp.

Jute Agricultural Research
Laboratories, Dacca,
Indian Central Jute Committee,
October 4, 1943. A. C. BOSE.

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A NEW ASCOMYCETOUS FUNGUS ON *SELAGINELLA*

THE fungi, so far recorded on *Selaginella*, are *Pythium Debaryanum* and *Synchytrium Selaginellæ* among the Phycomycetes; *Taphrina Selaginellæ*, *Acrospermum urceolatum* and *Leptosphæria helvetica* among the Ascomycetes; the Deuteromycete *Phyllosticta Selaginellæ*; and two smuts *Melanotænium Selaginellæ* and the Indian specimen *Entyloma polysporium*.[1] According to some[2] the smut recorded from India[3] as *Entyloma* bears greater resemblance to the genus *Melanotænium*. Recently Sydow[4] has described *Melanotænium oreophilum* as a new species on two Indian Selaginellæ.

The present specimen is an Ascomycete belonging to the order Sphæriales and the family Sphæriaceæ. The minute perithecia are globose and black and are found superficially in groups at the tips of vegetative shoots or sporangiferous spikes. They are black, smooth, hard, devoid of hairs and lack long beaks. However, an ostiole, situated on a minute papilla, is clearly visible under a lens. The ascospores, which are eight in number in each ascus, are oblong to spindle-shaped, hyaline and bi-celled. Paraphyses are present.

The fungus thus agrees with the description given[5,6] for the genus *Melanopsamma* to which it belongs. Studies based on microtome sections as well as measurements of spores, asci, etc., show that it is a new species. An interesting feature of this fungus is that its hyphæ grow down to a considerable extent, along the vascular bundle, from the tip, but do not affect other parts of the stem such as endodermis, cortex, etc., or the leaves. A full description of the fungus together with the naming of the species will be given elsewhere. It may be noted here that this is also the first record of *Melanopsamma* on any host in India. Butler and Bisby[7] and Mundkur[8] do not mention anything about this genus.

The present fungus was found growing on living *Selaginella chrysocaulos* in the Lloyd Botanical Gardens, Darjeeling, in the month of September.

Department of Botany,
University of Allahabad, A. K. MITRA.
October 5, 1943.

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CASES OF ANTIPODAL POLYEMBRYONY IN *ALANGIUM LAMARCKII* Thw.

A DETAILED review on polyembryony has already been published by Webber.[2] In most of the cases multiple embryos are formed by nucellar budding and these are sporophytic in nature. Development of additional embryos from the antipodals are comparatively of rare occurrence. Cases of antipodals developing further into adventitious embryos are reported by Ernst[1] in *Allium* and Woodsworth[3] doubtfully refers to such cases in *Alnus rugosa*.

In the course of the studies on the Gametogenesis and Embryogeny in *Alangium Lamarckii* Thw., the writer noticed in many cases, the antipodals developing into immature embryos. In normal cases the antipodal nuclei degenerate just prior to fertilization. But in some cases they become cellular. Such a cell

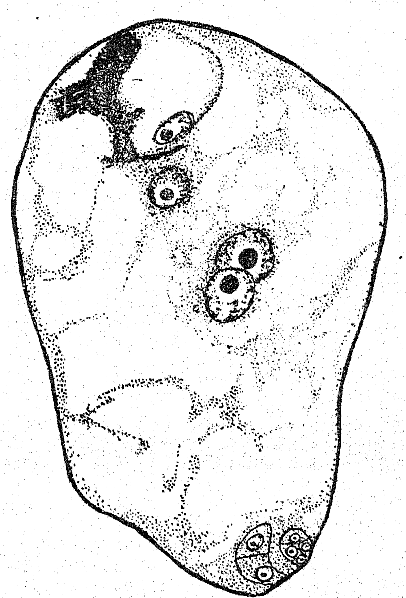


FIG. 1
Embryo-sac of *Alangium Lamarckii* showing antipodal polyembryony. × 700.

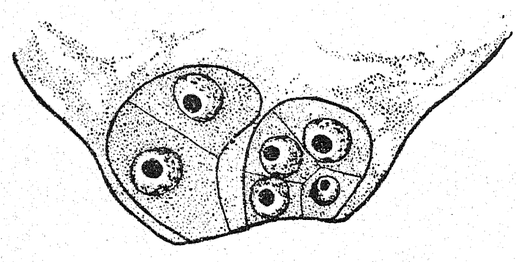


FIG. 2

Antipodal region of the same enlarge l ×1900.

divides by mitotic divisions to form a mass of 4 to 6 cells. Usually one to two antipodals of the embryo-sac develop in this manner individually. Further development of these antipodal embryos is arrested probably due to want of nutrition. Only the embryo developed from the fertilised egg matured and this fact has also been confirmed by seed germination tests.

The author is thankful to Dr. L. S. Dorasami, for facilities and guidance and to Mr. M. J. Thirumalachar for helpful suggestions.

Bangalore, D. M. GOPINATH.
October 19, 1943.

1. Ernst, A., "Bastarddierengals Ursache der Apogamie," in *Pflanzenreich*, 1918. 2. Webber, J. M., *Bot. Rev.*, 1940, **6**, 575–98. 3. Woodsworth, R. H., *Bot. Gaz.*, 1930, **89**, 402–09.

ON A VINE CHILLY IN MYSORE

IN Rayarakalhalli, a village six miles from Goribidnur, Mysore State, an unusual type of chilly plant is present. The plants are nearly six years old with apparent scandent habit. Consequently the plants have been supported on other trees. Material for the present study was made available by the kindness of Mr. N. R. Chikkannia, owner of the estate. A previous description of the plant that had appeared in the newspaper "*Hindu*" was based on the plants from the same garden.

The plants favour sciophytic (shade-loving) habitats. They are at present six years old, with branches supported to a height of 17 to 20 feet. An examination of the floral parts indicated that it is beyond doubt *Capsicum frutescens* L., but with minor variations. Comparative studies between the vine chilly plants and the local varieties of *Capsicum frutescens* with respect to floral parts, size, sculpturing and number of germ pores in the pollen grains, anatomy of the leaf-stem and root, and the size and distribution of the stomata, pointed out that the two plants are identical. Further, the similarity of the sizes of the stomata and the pollen indicate the improbability of the vine chilly plant having arisen as a result of polyploidy. In both the vine chilly plants and the local ones the leaves are ovate-lanceolate, with solitary peduncles, white flowers, drooping fruits which are tapering, curved or slightly reflex. The ovary is two-celled and rarely three-celled. A higher percentage of three-celled ovaries, however, occur in the vine chilly plants.

The scandent habit of the plants with branches growing to a length of nearly 20 feet is a feature so far unrecorded in any of the species or varieties of the genus *Capsicum*. A close study of nearly two hundred large plants and seedlings of the vine chilly plants were made with a view to observe if any splitting of characters occurred, thus indicating the heterozygous nature of the plants. In all the cases the plants were true breeding and uniformly similar.

It is manifest that the vine chilly plants are true breeding, closely resembling structurally *Capsicum frutescens* L. It is also apparent that their scandent habit is not due to etiolated conditions but a natural phenomenon. A new variety *Capsicum frutescens* L. var. *scandens* Narasimhan is designated for its accommodation.

A brief history of the plants as obtained from Mr. Chikkannia indicated that a few plants with vine habit were first observed in a plot with seedlings of *Capsicum frutescens* near Koratigere, Mysore State. Since the plants are all true breeding, their origin by way of mutation is not improbable. A detailed cytological study is bound to throw more light on this point. Another feature worth mentioning is that the vine chilly plants are extremely floriferous and the branches do not become scraggy at the end of the year as in the local varieties. Their perennial habit and sciophytic nature can be used with advantage in growing them in cocoanut and areca gardens. An attempt in this direction has already been made.

Dept. of Agriculture,
Bangalore, M. J. NARASIMHAN.
November 24, 1943.

ERGOT ON SUGARCANE IN MYSORE

IN the course of the collections of smuts on sugarcane in Mysore, elongated, yellowish-black sclerotia of ergot were noticed on sugarcane arrows; when they occur in abundance, the unaffected flowers cease to develop but remain sterile. The persistent tuft of bristles at the base of the glumes helps the dispersal of the sclerotia just in the same manner as the normal seeds. Such a mechanism of dispersal has been reported by Stager[1] in the ergot on *Calamogrostis epigeios*.

Ergot on sugarcane has been recorded as stray occurrence from the Philippines by Ocfemia[2] on the basis of the material collected by Messrs. Simon Perez and Pedro Juachon, and has so far not been recorded from any other place. The abundance of sclerotia observed in the present study is encouraging. The mass of flowers in the arrowing varieties of sugarcanes is enormous, and by proper inoculation and dissemination of infection it

should be possible to secure a large-scale production of ergot.

Department of Botany,
Central College,
Bangalore,
November 25, 1943.
M. J. THIRUMALACHAR.

1. Stager, R., *Centralbl. Bact.*, 1922, **2**, Abt., 56, 329–39. 2. Ocfemia, G. O., *Philip. Agric.*, 1931, **19**, 581–89.

OBSERVATIONS ON TWO MAMMALIAN COCCIDIA

IN June 1943, I found some fresh öocysts from the rectal contents of the rabbit *Lepus* sp. and the common Indian goat *Caprahircus* Linn.; both the hosts were collected from the suburbs of Calcutta. The öocysts of the rabbit when fully matured were found to be identical with *Eimeria stiedæ* (Lindemann, 1865), while those of the goat were found to be synonymous with *Eimeria faurei* (Moussu and Marotel, 1901).

E. stiedæ is being reported for the first time from India. *E. faurei,* though reported before from Indian sheep by Baldrey[1] (1906), the Indian goat *C. hircus* is added as a new host of this parasite.

The öocysts of *E. stiedæ,* measuring $30 \cdot 2 - 37 \cdot 4\,\mu$ by $22 - 26 \cdot 4\,\mu$, are ovoid in shape, light-brown in colour and flattened at one pole, as stated by previous workers. A micropyle is present at the flattened end of the öocysts. There is a well-defined spherical öocystic residual body about $1\,\mu$ in diameter. The sporocysts and the sporozoites have the same form and measurements as given by the previous authors. A residual body is also present in the sporocysts.

The öocysts of *E. faurei,* measuring $26 \cdot 4 - 30 \cdot 8\,\mu$ by $22\text{-}24 \cdot 2\,\mu$, are ovoid in shape and brownish in colour. There is a micropyle closed by a cap at one end of the öocyst. Wenyon[2] (1926) states that the öocystic residuum may or may not be present, but I could not find any öocystic residuum at any stage of development of the öocyst though a sporocystic residual body is present, as stated by him. A micropyle is present at the pointed end of each of the sporocysts and sporozoites have the same features as stated by previous observers.

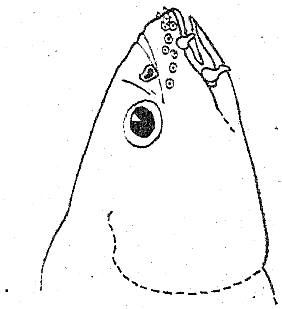
I am indebted to Mr. M. Chakraverty for his guidance and valuable suggestions and also to Prof. H. K. Mookerjee for kindly allowing me to work in this Laboratory.

Zoological Laboratory,
University of Calcutta,
July 24, 1943.
AMIYA BHUSAN KAR.

1. Baldrey, F. S. H., *Jour. Trop. Vet. Sci.*, 1906, **1**, 387. 2. Wenyon, C. M., *Protozoology*, 1906, **2**, 830–844.

SEXUAL DIMORPHISM IN *SCHIZOTHORAX LONGIPINNIS* HECKEL

IN a collection of fishes made from the Dal Lake, Kashmir, in August 1938, there are numerous immature specimens of *S. longipinnis* Heckel, besides four full-grown specimens of the same species. Two of the four specimens possess smooth-skinned heads while the other two could be marked out by the presence of tubercles on the snouts and comparatively lean bodies. The tubercles are arranged in two groups, one on either side of the mid-dorsal line. On dissection it was found that both the smooth-skinned specimens are females possessing well-developed ova, while the tuberculated ones are males. The bigger male has 29 such tubercles while the smaller one possesses only 14. From the above observation it can be concluded that at the time of maturity the males of *S. longipinnis* develop "nuptial organs" which become more pronounced as the breeding season approaches.



Head of a male specimen of *Schizothorax longipinnis* Heckel, showing tubercles on the snout. ca. Nat. size.

There does not seem to be any appreciable difference in the length of the fins in the two sexes. Since the specimens have been preserved in formalin, the exact coloration could not be noted.

The largest specimen in the collection is a male measuring $322 \cdot 0$ mm., while in female measuring only $249 \cdot 1$ mm. in length.

Department of Zoology,
Panjab University,
October 26, 1943.
NAZIR AHMAD.

A PROBABLE INSTANCE OF RECAPITULATION IN DECAPOD LARVÆ

IN a paper published in 1937 on decapod larvæ from the Madras plankton[1] I had stated that the last two larval stages of *Albunea* possessed 12 and 13 gills respectively. Since the number in the adults is 10, I had ventured to state that this may be an instance of recapitulation of an ancestral character. Only two specimens belonging to the last stage were available at that time, so that the observation could not be confirmed then.

Recently I have been able to obtain several specimens belonging to both stages and on examination my previous observation has been found to be correct. It can, therefore, be definitely stated that the presence of a larger number of gills in these larvæ is a normal character and not an occasional abnormality.

In the corresponding stages of a closely related form, *viz.*, *Emerita,* the number of gills

is 8, one less than the adult number.[2] In other respects these larvæ resemble one another closely. The difference in regard to number of gills in *Albunea* larvæ may not, therefore, be correlated with any peculiarity in their habits. When it is remembered that the ancestors of both the Anomura and Brachyura are believed to have been forms with numerous gills there is very strong reason to assume that the larger number of gills of these larvæ is a clear case of recapitulation by the free-swimming larvæ of an ancestral character. It should therefore, be of considerable interest in view of the fact that recapitulation has generally been denied to occur among these larvæ.

Maharaja's College,
Ernakulam, M. KRISHNA MENON.
November 9, 1943.

1. *Bulletin of the Madras Government Museum*, New Series—Natural History Section, **3**, No. 5. 2. *Ibid.*, **3**, Nos. 3 & 4.

A NOTE ON THE OCCURRENCE OF CHLORITOID IN TUMKUR DISTRICT, MYSORE STATE

IN the course of a visit to parts of the Chitaldrug Dharwar Schist Belt in the Tumkur District, the writer came across a band of schist which contains the mineral chloritoid. As far as the writer is aware, there is only one reference to this mineral in the *Records of the Mysore Geological Department*. This is by the late Mr. B. Jayaram[1] who mentions the occurrence in the Hassan District, of "chloritoids" in the ultrabasic rocks north of Raipur, and of "a chloritoid mineral" in the hornblendic dykes north-west of Raipur. By the courtesy of Mr. B. Rama Rao, the Director of Geology in Mysore, the writer had an opportunity of examining microsections of these rocks referred to by Mr. Jayaram, but did not find any occurrence of chloritoid in them.

The exact locality where the chloritoid bearing schists are found is about two miles east-north-east of Banasandra railway station (on the Bangalore-Harihar Section), and about a furlong north-east of Lakkasandra village (1" topographical sheet No. 57 C/11).

The schist is greyish-green in colour, and when weathered has a dirty green colour which becomes brown in highly weathered specimens. Chloritoid occurs abundantly scattered in this rock, in disc-like, lenticular, or irregular shapes. The mineral is black in colour, and glistens brightly. The discs vary in diameter from 0·5 mm. to 2 mm.

The mineral has an almost perfect basal cleavage. Imperfect prismatic cleavages intersect at angles of 120°, and there is a parting parallel to 010.

Under the microscope, the schist is mainly composed of chlorite, sericite, and quartz. Grains of ilmenite altering into leucoxene are common. Crystalloblasts of chloritoid occur anyhow in the rock without any relation to the directions of schistosity. Crystals athwart the lines of schistosity are often seen to have pushed apart the flakes of chlorite and made room for themselves; this is because of the high force of crystallisation of chloritoid. The schistosity planes (represented by specks of ilmenite) are sometimes seen to pass right through the porphyroblasts of chloritoid. The mineral is poeciloblastic and contains abundant inclusions of quartz and ilmenite.

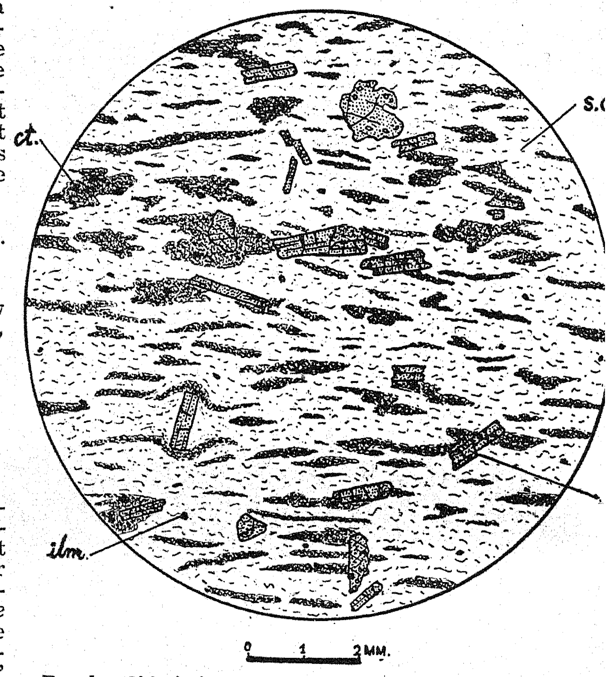


FIG. 1.—Chloritoid Schist, Lakkasandra, Tumkur Dist. *Cd.*—chloritoid. *Ct.*—chlorite. *s.e.q.*—sericite, chlorite, quartz. *ilm*—limenite.

The mineral is strongly pleochroic. The following is the pleochroic scheme: X = green, Y = indigo blue and Z = pale greenish yellow. The mineral has a high relief, but very low birefringence. The birefringence was measured by means of a Berek's compensator and the value obtained was $\gamma - \alpha = \cdot 009$ to $\cdot 01$. The direction Z makes an angle of 9° with the normal to 001. The optic sign of the mineral is positive.

Twinned crystals are common, the composition plane being parallel to 001. The composition plane is sometimes irregular.

Chloritoid is a typical stress mineral which is produced in a very low grade of regional metamorphism (epizone), though it is known sometimes to occur in the almandine zone.

The mineral is characteristic of sedimentary rocks which contain alumina in abundance and iron in sufficient quantities, and which are relatively poor in magnesia, lime, and potash. Its discovery, therefore, in the Dharwar schists of Mysore is interesting.

Department of Geology,
University of Mysore,
Central College,
Bangalore, C. S. PICHAMUTHU.
December 8, 1943.

1. Jayaram, B., "Progress Report on Work done during the Field Season of 1920–21", *Recs. Mys. Geol. Dept.*, **1923**, **21**, 62, 63.

THE CALCULATION OF THE CRITICAL SHEAR STRESSES AND THE SEDIMENT SIZES

THE writer[1] has recently worked out a theoretical solution of the critical shear stress, based on the assumption that the force impressed on a sediment layer by the moving fluid is proportional to the force exerted on the particles by their own weight, when falling freely in a stationary fluid column. The impressed force has been calculated from a consideration of the loss of momentum (Karman Theorem[2]) and for the stage of motion qualified as *general*, it has been deduced, provided the particles have the same fineness ratio, that

$$\tau_c/\rho_w \, V_s^2 = f(\rho_w \, U_{\tau_c} \, k/\mu) = F \; (\rho_w \, V_s k/\mu), \qquad (1)$$

where

τ_c = critical shear stress at the stream bed $[M L^{-1} \; T^{-2}]$,

$U_{\tau_c} = \sqrt{\tau_c/\rho_w}$ = critical shear stress velocity at the bed $[L T^{-1}]$,

μ = fluid viscosity $[M L^{-1} \; T^{-1}]$,

ρ_w = fluid density $[M L^{-3}]$,

V_s = terminal velocity of the sediment particles $[L T^{-1}]$, and

k = particle diameter $[L]$.

These relations check well against observation and the solution of any relevant practical problem can be had from the two figures given in the paper cited.

However, in actual application, it is not possible to estimate the particle size, from a known value of the threshold shear stress, in a straightforward manner. Here, recourse must be had to the tedious process of successive approximations, and this, obviously, is very unsatisfactory. To overcome the difficulty, I suggest the following procedure.

It is easy to verify that

$$(\rho_s - \rho_w) \; gk \propto \rho_w \, V_s^2 \, \phi \; (\rho_w \, V_s k/\mu), \qquad (2)$$

where ρ_s $[M L^{-3}]$ is the density of the sediment particles and g $[L T^{-2}]$ is the acceleration due to gravity. So making use of this, we are led from (1) to the result

$$\tau_c/(\rho_s - \rho_w) \; g \, k = f_1 \; (\rho_w \, U_{\tau_c} \, k/\mu)$$
$$= f_2 \; (\rho_w^2 \, U^2_{\tau_c} \, k^2/\mu^2). \qquad (3)$$

We multiply the respective coefficients in f_1 and f_2 by the left-hand side parameter $\frac{\tau_c}{(\rho_s - \rho_w) gk}$ and its reciprocal $\frac{(\rho_s - \rho_w) \, gk}{\tau_c}$, and so set up

$$\frac{\tau_c}{(\rho_s - \rho_w) \, gk} = f_3 \left[\left(\frac{\rho_w}{\mu} \right) \; \frac{U{\tau_c}^3}{(\rho_s/\rho_w - 1) \; g} \right], \qquad (4)$$

and

$$\frac{\tau_c}{(\rho_r - \rho_w) \, gk} = f_4 \left[\left(\frac{\rho_w}{\mu} \right)^2 (\rho_s/\rho_w - 1) \, gk^3 \right]. \qquad (5)$$

In these relations, the dependence of τ_c and k on $\tau_c/(\rho_s - \rho_w) \, gk$ is separately shown. It follows then from (4) that we need only know τ_c to calculate k, the numerical values of ρ_s, ρ_w and μ being given. For the estimate of τ_c, when k, ρ_s, ρ_w and μ are given, we normally use the result

$$\tau_c/\rho_w \, V_s^2 = F \; (\rho_w V_s k/\mu).$$

But consistent results are obtained, if the functional relation (5) is employed instead.

Also, the numerical estimate of k, for a given value of τ_c, or *vice versa*, can be made with equal ease and as readily, from a diagram, showing χ_1 plotted against χ_2, where χ_1 and χ_2 stand for the respective coefficients in f_3 and f_4. These parameters are plotted against one another in Fig. 1, $-\chi_1$ as ordinates and χ_2 as abscissæ.

The delineated curve is a good representation of the experimental spots. To the extreme left, the dotted portion is the one in better agreement with observation, though certain theoretical considerations demand it to be like the full line.

The annexe to the figure shows two experimental points by Dr. White,[9] along with some of the points from the main figure. Dr. White's investigation was with sand of mean grain diameter 0·21 mm. and 0·9 mm. respectively. Lubricating oil was used as the fluid, and steady viscous motion was maintained throughout the stream.

Through these points, a smooth curve has been passed, which, if put alongside the main curve, merges into it. This curve has a gentle declination, so much so, that the dotted straight line, whose equation is

$$U\tau_c \cong 0{\cdot}464 \left[\left(\frac{\mu}{\rho_w} \right)^{0\cdot24} \left(\frac{\rho_s}{\rho_w} - 1 \right)^{0\cdot38} g^{0\cdot38} \, k^{0\cdot14} \right] \quad (6)$$

makes with the x-axis an angle of about 8° only.

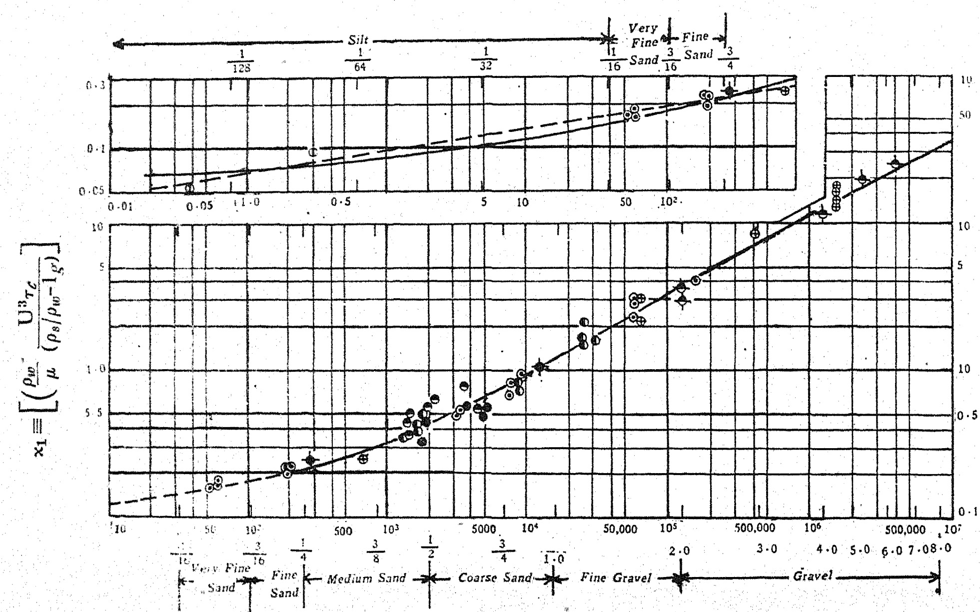
On the other hand, the full curve (in the main figure) tends asymptotically, to the left, to a constant value. Its simple physical explanation is that, at low χ_2 values, the critical shear stress tends to be governed mainly by viscosity. Here the critical shear stress velocity equation reads

$$U\tau_c \cong 0{\cdot}59 \left[\left(\frac{\mu}{\rho_w} \right)^{\frac{1}{3}} \left(\frac{\rho_s}{\rho_w} - 1 \right)^{\frac{1}{3}} g^{\frac{1}{3}} \right] \qquad (7)$$

and holds for values of $\chi_2 \leqslant 275{\cdot}0$.

However owing to lack of sufficient experimental data, it is not possible to be quite definite about the shape to the left. To be able to decide whether or not the discrepancy between theory and experiment is real, we shall need further experimental evidence.

The main curve to the right rises off, at first slowly and then quite fast, the slope of



$$\chi_2 \equiv \left[\left(\frac{\rho_w}{\mu}\right)^2 \left(\frac{\rho_r}{\rho_w} - 1\right) g\, k^3\right]$$

FIG. 1

Curve from which can be derived the value of k for a given value of τ_c or *vice versa*.

Observations of H. J. Casey[3] with uniform grains ⊙; of H. J. Casey[3] with mixtures ◐; of G. K. Gilbert[4] with uniform grains ⊕; of P. Y. Ho[5] with slaty mixtures; of H. Kramer[6] with mixtures ●; of P. Srichamara[7] with uniform grains; of the U. S. Waterways Experiment Station[8] with mixtures; of Dr. C. M. White[9] with uniform grains ⦶.

the straight line to the right ($\chi_2 \geqslant 2 \cdot 25 \times 10^5$) being 26° 34′. Here the inertia terms become the predominant terms and the critical shear stress velocity is given by the formula.

$$U\tau_c \cong \frac{1}{4 \cdot 5}\left[\left(\frac{\rho_s}{\rho_w} - 1\right)^{\frac{1}{2}} g^{\frac{1}{2}}\, k^{\frac{1}{2}}\right], \qquad (8)$$

which does not contain the viscosity term, μ. This might have been foreseen.

In the range $275 \cdot 0 \leqslant \chi_2 \leqslant 2 \cdot 25 \times 15^5$, both viscosity and inertia terms affect the transport. But over the range $2 \cdot 25 \times 10^3 \leqslant \chi_2 \leqslant 2 \cdot 25 \times 10^5$, the coincidence of the curve with the straight line law (8) is quite close for most of the practical problems. And so, the application of (8) could be extended up to $\chi_2 \cong 2 \cdot 25 \times 10^3$.

Most of the practical problems concern sand of mean density 2·65 gm./cm.^{3} And so, assuming $\mu/\rho_w = 0 \cdot 01007$ cm.^{2}/sec. (corresponding to water temperature of 20° C) and $g = 981 \cdot 0$ cm./sec./sec., values of χ_2 have been calculated and the corresponding particle sizes (in mm.) are marked in the figure. This arrangement, it is hoped, will prove of aid in practice.

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October 11, 1943.

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REVIEWS

Time Bases (Scanning Generators). By O. S. Puckle, A.M.I.E.E. (Chapman and Hall, Ltd., London), 1943. Pp. 204. Price 16*sh.* net.

Time Base is the name given to those electrical devices or circuit arrangements which produce deflection potentials of suitable types for cathode-ray tubes as employed in the television or oscillograph techniques for visual observation of electrical phenomena. These potentials are made to vary at known rates with time and hence the modern name. For television purposes as also in many applications of the oscillographic work, the familiar "Saw-tooth" time base is employed in which the rate of change is made linear with time. In case of special kinds of oscillographic work electrical circuits have been developed giving potentials varying with time in a sinusoidal, circular, radial or spiral manner as the nature of the work demands.

Time base can aptly be described as the "brains" of the whole cathode-ray oscillograph outfit in that it decides how a recurrent electrical phenomenon will appear on the fluorescent screen. Its choice "may make all the difference between success and failure" as the author says in the introduction. In spite of the fact that developments on the time bases, trigger circuits, etc., have been largely responsible for the versatility of the cathode-ray oscillograph in its manifold uses, one does not find them adequately treated in any book published so far on the subject. Need, therefore, has keenly been felt for a unified treatment in one place of the underlying principles and common-sense involved in the design, construction and uses of such circuits. The book under review does more than fulfil this hope. In a series of enlightening chapters and appendices it gives a coherent account of the basic theory in the evolution and development of various kinds of time bases, their designs and modifications, etc., in proper historical perspective.

The book is divided into ten chapters and seven appendices. The reviewer feels that the scope of the matter covered by the book can be properly gauged by giving the chapter headings which run as follows:—

I. Introduction, II. Time base wave forms, III. Types of time base, IV. Trigger circuits, V. Blocking oscillators and inductive time bases, VI. Polar co-ordinate, multiple and velocity modulation time bases, VII. Linearization of the trace, VIII. Push-pull deflection, IX. The synchronization of time bases, and X. The use of a time base for frequency division.

For consistency of the treatment several important topics are dealt with in a series of appendices; they are vital to the main subject. For instance, a short description of the advanced aspects in the design of cathode-ray tube is given in Appendix I; the remaining six being devoted to, respectively, the curvature of the charging characteristic, the characteristics of a gas-discharge triode as a time base discharger valve, differentiating and integrating circuits, the generation of square waves, a method of changing the phase of a sinusoid and the effect of large shunt capacitances in the anode circuit of a valve.

A short bibliography and an index are given at the end.

A number of neat circuit diagrams and a few plates illustrate the volume.

The author who is a research engineer with Messrs. A. C. Cossor Ltd., London, is a well-known exponent of this art of electronic jugglery and is himself responsible for devising a few of these circuits; particularly, the hard valve time base which has extended the frequency limitations of the utility of the cathode-ray oscillatigraph from 50 kc./s. to 1000 kc./s. It is interesting to mention here that recent development of the deflection modulated type of tube, called the signal converter, is reported to have resulted in an all-round improvement in the cathode-ray tube performance.

The book is critically written—a virtue most essential to works of this type yet not often found. It essentially describes the technique as developed by the British with a few German and American circuits "thrown in" for the sake of completeness. It is free from misprints and errors. It is a fine example of its kind, authoritative, accurate and compact, but clear and cleverly written. The author has earned the gratitude of numerous workers in this field who will do well to assimilate the book rather than try to skim through.

It is indispensable to those interested in the electronic art and science. N. B. BHATT.

Switchgear Practice. By Arthur Arnold. Chapman & Hall, Ltd., London), 1942. Pages 238 + iv. Price 22/-.

In recent years developments have been rapid and are still proceeding in almost every kind of switchgear, and a survey of practice, a sort of stock-taking as it were, is certainly useful from many points of view. This book by Mr. Arnold is a brief review of that kind and is, therefore, welcome. Again, consideration of switchgear enters into every industry and quite often engineers with very little or no experience in this field are called upon to deal with matters concerning its design, installation and operation. To them this book should serve as a useful guide as it enables them to some extent to appreciate aspects involved in the selection of switchgear.

The scope and aim of the book can be best understood by a perusal of the headings of the nineteen chapters into which the book is divided. They are: D.C. Circuit Breakers; Specialised D.C. Circuit Breakers; D.C. Motor Starters; D.C. Switch Boards; A.C. Circuit Breakers of Small and Medium Size; A.C. Motor Starters; A.C. Busbar Layout; A.C. Switchgear Types; Heavy Duty Circuit Break-

ers; Arc Control Devices; Isolation and Bus Selection; Methods of Circuit Breaker Operation; Interlocks; Switchgear Testing; Protective Devices on Switchgear; Instrument and Control Boards; Lightning Arresters; Fire Prevention and Protection; Oil-less Circuit Breakers. Each chapter is independent in itself and contains useful and up-to-date information on the topic selected. On account of the vastness of the field sought to be covered and the space limitations of a book of this size, rigid selection of the material is inevitable, but it can be confidently said that no material point has escaped notice. A comprehensive list of all relevant B.S.S. and a fairly representative bibliography on the subject given at the end of the volume, are useful additions.

S. KRISHNASWAMY.

Electrotechnics—*Journal of the Electrical Engineering Society*, Indian Institute of Science, Bangalore. Nos. 15 and 16, 1943.

We have received a copy of the current year's issue of this Journal. As the organ of the Electrical Engineering Society of the Indian Institute of Science, Bangalore, this Journal is known for the high standard of the articles published and we are glad to note that the issue under notice has maintained that standard. It contains thirteen well-thought-out articles of interest to the Electrical Engineering profession, mostly by Engineers with experience in the field they write upon. Editorial, Correspondence, Book Reviews, and News and Notes are among the other items.

It is a pity that no issue of this useful Journal could be brought out last year. We hope that its publication will go on uninterrupted from now on.

S. K. S.

The Carnivorous Plants. By Francis Ernest Lloyd. (Chronica Botanica Co., Waltham, Mass.; Calcutta: Messrs. Macmillan & Co., Ltd.), 1942. Pp. xvi + 352, 38 plates and 11 text-figures. Price $6.00.

The book under review, a monograph on the carnivorous plants, coming, as it does, from one who has devoted much valuable time in delving into the mysterious ways of the plants in question here, Prof. Francis Ernest Lloyd, Professor Emeritus in the McGill University, Canada, is an authoritative work, and its great usefulness to research workers in this field and to interested botanists in general must at once be recognised. Its appearance in print is most welcome, and Prof. Lloyd has spared no pains to make the account quite comprehensive and up-to-date.

Of the carnivorous plants, there are, excluding certain fungi, about 500 species representing fifteen genera of the flowering plants, and these fall into two groups, one under the Chloripetalæ, and the other under the Sympetalæ. Thus the peculiar and the very aberrant mode of nutrition exhibited by these plants must have been derived at least along two independent lines in the course of the phylogenetic history of the flowering plants.

The structural details exhibited by these plants and the exact mechanism involved in the capture and digestion of the prey are so many and so varied and complex, that it is hard to find one who could do justice to the subject other than the author himself. He classifies these plants into two major categories, the first where the traps are passive, with pitfalls, snares and fly-paper mechanism, and the second with active traps which display special movements necessary or contributory to the capture of the prey. In the different chapters of the book the carnivorous plants which come under these two groups are dealt with separately and in great detail.

In some, as in *Heliamphora, Darlingtonia and Pinguicula*, the digestion of the prey is brought about by bacteria contained in the pitcher fluids, whereas in a few others, as in *Sarracenia* and *Cephalotus*, the digestion is mainly due to the secretions from the glands, although bacteria may aid to a certain extent. In *Nepenthes* there are two enzymes—a catheptic and a tryptic—concerned in digestion, but there are also large numbers of bacteria in the pitcher fluid and these may only play a very secondary role.

After giving a resumé of the several interpretations regarding the morphology of the pitcher leaves in *Nepenthes*, Prof. Lloyd draws attention to the many interesting structural features of the pitchers and their role in ensnaring the unfortunate victims. And here it is interesting to refer to his observations. The insects walking on the lid of the pitchers run no risk of capture. "On the rim", however, it is supposed that they do. As a matter of fact, however, they do not, for they walk on it in any direction with rapidity, and they frequently stop to take the nectar from the marginal glands. They even passed underneath the rim and back several times in one excursion without danger. If, however, they venture on to the waxy zone they at once display a quite different behaviour. They cannot then by any chance move rapidly forward. If they progress at all, it is very slowly and with much groping with the legs as if searching for a hold. Usually this results in a complete loss of the foothold, and the ant falls into the abyss."

There are various associates which the pitchers harbour, and it is interesting to note that these constitute a "terrestrial fauna" above the level of the fluid, and an "aquatic fauna" in the fluid.

The eel-traps of *Genlisea* are remarkable for their structural complexities, and there is a good deal of speculation regarding the function of the glands here. They may secrete mucilage to facilitate passage of the prey down the trap, or they may secrete digestive enzymes, or both. Bacterial action may not, however, be completely excluded in digestion. In both *Dionœa* and *Aldrovanda* which display the steel-trap mechanism the mode of capture of the prey is essentially similar and digestion is due to the secretions by the glands found on the inner surfaces of the traps.

In the chapter on *Drosera*, the phenomenon of aggregation in stimulated tentacles is fully

dealt with and the cytological and physiological complexities involved in the process of digestion are discussed in detail. After reading through this chapter the reader is brought to the realization of the fact that the whole process of digestion in *Drosera* is not, contrary to what one learns from the usual accounts, a simple one. Prof. Lloyd points out the many-sided interest of this problem, and emphasises the need for further work in this promising field.

By far the most wonderful of the carnivorous plants is *Utricularia* belonging to the family Lentibulariaceæ. In this family we find examples of the simplest traps (*Pinguicula*), the most complex of the pitfall type (*Genlisea*), and the incomparable trap of *Utricularia* itself. Prof. Lloyd compares the trap of *Utricularia* to a mouse-trap, not the ordinary simple dead-fall one, but an elaborate, automatic, self-setting mouse-trap which catches as fast as the victims come, and which is provided also with a disposal plant so that nothing is left at last but hair and bones, the trap working in any position and even under water. This analogy may be rather far-fetched, but as Prof. Lloyd remarks, it at least serves to indicate that the *Utricularia* trap is a pretty complex bit of mechanism.

While ordinary accounts of the carnivorous plants do not include the fungi which prey on animalcules, a chapter in the present book is devoted to the zoophagus fungi. It is interesting to read how uncanny these fungi are and what diabolical methods they employ in capturing their victims.

The origin and evolution of the carnivorous plants are some of the interesting questions that arise in the minds of interested readers, but unfortunately little can be said in answer to them, and as Prof. Lloyd says, how these specialised organs of capture in these plants could have evolved defies our present knowledge.

All students of botany interested in this subject will be sure to have nothing but praise for the book, and gratitude to the author for making his extensive and intimate knowledge of these plants available to a very large circle of readers. Throughout the book the language is simple and lucid, and the style thoroughly enjoyable. The book is profusely illustrated with numerous photographic reproductions and excellent line drawings, many of them prepared by Prof. Lloyd himself. The usefulness of the book is further enhanced by the incorporation under different chapters of all the original and up-to-date literature in this field.

The get-up of the book leaves nothing to be desired, and the price is quite modest. Considering the present difficulties due to war, the publishers deserve our warmest congratulations for bringing out this volume, the ninth in the new series of plant science books under the editorship of Dr. Frans Verdoorn. This book is an outstanding contribution to botanical science by Prof. Lloyd and ought to find an important place in every botanical and general science library. S. B. KAUSIK.

Indian Village Health. By J. N. Norman-Walker. (Oxford University Press, Madras), 1943. Pp. 90. Price Rs. 2-8-0.

In this small book, the author has made an attempt to deal with most of the important health problems affecting Indian village life. General principles in the handling of the common Communicable Diseases have been dealt with. Local experience seems to have unduly influenced some of the observations of the author and several of the detailed recommendations under Malaria, Small-pox, Water and Milk have been superseded by more up-to-date practices.

The absence of stress on the importance of grain movements as a major source of spread of plague and the necessity for early diagnosis of cases of Tuberculosis are serious omissions. The use of copper-sulphate for destroying harmful organisms in water is limited to the prevention of objectionable algæl growths only.

The brief notes given under Appendix is helpful for the field worker in Public Health. The few model plans included at the end of the book, are useful in designing construction of public utility. B. ANANTHASWAMY RAO.

An Introduction to Historical Plant Geogrphy. By E. V. Wulff. (Waltham, Mass.: The Chronica Botanica Co.; Calcutta: Macmillan & Co., Ltd.), 1943. Pp. 223. Price $4.75.

The book gives a fascinating account of the History of Plant Geography. As is usual with the Chronica Botanica publication series, the book is written by an acknowledged authority and includes most of the works of the author himself. The entire work is divided into eleven chapters and embraces all aspects of plant geography. It will be noticed that every advance in the field of Botany has some bearing or the other on the study of plant geography.

It is not possible within this short space even to review the wealth of facts presented in the book. But a very brief account of the subjects treated therein might not be out of place. But one must certainly go through the accounts given in the book to get a proper perspective of the importance of the study of plant geography.

The region of distribution of any taxonomic unit which is termed an area, might be natural, or artificial by intentional or accidental introduction by man. The topography which is affected by physico-geographical conditions is often made difficult to be comprehended on account of inherent peculiarities of the plants themselves. Some are stenothermic (growing within certain restricted temperatures), others require mycorrhiza for their growth or even a particular type of insect visitors. The latter forms are usually termed stenotopic.

Regarding areas and their distribution, a detailed account of the present status of the "age and area" hypothesis is given. It is well known that the centre of an area for a parti-

cular genus, is the place where there are the maximum number of its species. Regarding the endemics, based on the floristic studies of Ceylon and New Zealand, Dr. Willis concludes that the endemic species which occupy the smallest areas in those islands are young, and that the area of the species is proportional to age. As Dr. Wulff has pointed out, this does not explain the cases of endemics which have acquired their monotypic character as a result of the dying out of most of their species. Endemism might be the result of taxonomic isolation, in which case it might be young, as compared with the endemics which manifest phylogenetic antiquity. Various terminologies to differentiate the two types, including the use of the terms, neoendemics and palæo-endemics, are given.

A discussive account of various species and their possible origin due to edaphic factors is given. The importance of plant rusts and plant lice in gleaning out the facts about past distribution of plants is finely illustrated. This indirect method of study is useful where evidences from fossil records are lacking.

In the chapter on artificial factors in the geographical distribution of plants, the role of man in distributing and changing vegetation is pointed out. Considering the vastness of the flora, man's part is insignificant in changing the character of an area.

Referring to natural factors concerning geographical distribution of plants, such as wind, importance of competition among plants to inhabit new areas, or between the new comers and those already present is stressed. The necessity of understanding the past history of the globe to explain discontinuous distribution is explicitly stated. In this connection a comprehensive account of Wegener's theory of Continental drift as supported by phyto-geographical studies is given. Diel's criticism of Wegener's hypothesis is shown to be not in keeping with facts. In the last chapter concepts of floral elements such as geographical, ecological and historical elements are elegantly described. The book is a very valuable addition to the Chronica Botanica series and must have a wide circulation it deserves.

M. J. THIRUMALACHAR.

SCIENCE NOTES AND NEWS

On the Production of Carbarsone.—Mr. A. K. Bose, of the Indian Research Institute, Ltd., Calcutta, writes:—Carbarsone, the carbamido derivative of arsenilic acid, is one of the most innocuous of the organic arsenicals. Its amœbicidal action is directly connected with its arsenic content. Theoretically it contains 28·8 per cent. arsenic; but as the drug is being marketed in tablets and gelatin capsules containing 0·25 gm., it is of special importance to see that its content of arsenic as demanded by the above amount of the drug, is strictly maintained. The arsenic content of "Carbarsone" usually available in the market is sometimes found to be lower than the standard (28·1 to 28·8 per cent.).

The compound has now been prepared in this laboratory and has been found to be upto standards and specifications as mentioned in the *New and Non-official Remedies*, 1939. The product melts at 172° with decomposition and the arsenic content as determined by the U.S.P. XI method has been found to be 28·7 per cent. in average, indicating thereby, that a technique of producing carbarsone with arsenic content just within the limit as specified in the N.N.R. has been developed in the country.

Post-War Agricultural Policy in India: Planning for Self-Sufficiency in Manurial Requirements.—Dr. C. N. Acharya writes:—

One of the bitterest lessons taught this country by the present war is the great weakness in the national economy in having to depend on imports from foreign countries in order to meet the normal food requirements of the country. A searching analysis of the failure of the country in recent decades to meet the food requirements of its increasing population, shows this failure to be due ultimately to the low fertility level and crop-yielding power of Indian soils. In any post-war agricultural policy, a systematic planning for improving the fertility status of Indian soils should occupy the most prominent attention. Such planning would envisage primarily the production and application of greater quantities of fertilizers and manures to the land than are done at present.

In considering various methods of tackling the manurial problem, weightage should be given to a policy which would stand the stress of prolonged war conditions. Dependence on imports of fertilizers for maintaining food production in the country is no sounder policy in war time than dependence on imports of food materials themselves. So far as India is concerned, her local resources of mineral phosphates are limited and in the matter of nitrogenous fertilizers, her internal production is also low at present. Even supposing that the production of nitrogenous fertilizers by fixation from the air could be increased greatly after the war, it is well known that most of this production would be diverted for the manufacture of explosives in war-time.

In the light of the above considerations, it would be seen that the soundest policy to be adopted in our post-war agricultural reconstruction in India would be to concentrate on increasing the quantity and quality of organic manures that could be produced within the country itself.

The two chief sources of organic manure that are available in this country are farmyard manure and town refuse compost—the quantities of oil-cake, fish meal, etc., available being quite small in comparison. Farmyard manure has been the staple manure of this country for centuries past, but unfortunately it is unable to satisfy in full the present manurial requirements of our agriculture, since (*a*) the quantity of farmyard manure produced is much smaller than what could be made available from a bovine population of over 200 millions maintained in this country, on account of the widespread custom of our farmers, of converting cattle dung into fuel cakes; (*b*) the quality of the manure produced is very poor on account of defective methods of preparation; (*c*) the most important constituent of animal excreta, *viz.*, urine, is almost wholly wasted under existing conditions; and (*d*) the miscellaneous odds and ends of vegetable and habitation refuse that are available on the farms and in farmers' houses are not systematically collected and utilized for manure preparation.

The experiments and trials carried out by the writer at Bangalore, Poona, Surat and other centres, have shown that the quantity of farmyard manure that could be prepared can be increased by 50 per cent. and the contents of nitrogen and phosphoric acid could be increased from 0·5 per cent. and 0·3 per cent. respectively (on dry basis) on average samples by the farmer's method to about 1·5 per cent. and 0·8 per cent. respectively by the improved method.

The practical possibility of utilizing town wastes on the large scale for conversion into agricultural manure has attracted the attention of the Government of India, who have recently sanctioned a special grant for organizing the preparation of compost manure from municipal wastes in all the major Provinces and States in India. Under this scheme, which is operated by the Imperial Council of Agricultural Research, Special Biochemist Officers have been appointed in the major Provinces and States in India, with necessary staff for organizing compost production work at urban centres in their respective areas. The above Biochemist Officers have undergone intensive training in the theoretical and practical aspects of compost making for a period of six months under the guidance of the Chief Biochemist to the Imperial Council of Agricultural Research.

It is suggested that the staff of Compost Biochemists and Assistant Chemists already appointed in each Province, primarily for dealing with town wastes, may be more fully utilized by empowering them to take into their purview the problem of introducing improved methods, of farmyard manure and farm compost preparation into the rural areas in their respective Provinces and States; and that for this purpose the present staff may be strengthened by the appointment of a number of Compost-Khamghers or Maistries attached to each Assistant Chemist, who would specifically deal with the widespread introduction of the improved process for the treatment of farm wastes in rural areas.

India's Mineral Industries.—In the course of his Presidential Address to the Nineteenth Annual Session of the Geological, Mining and Metallurgical Society of India, held on the 29th November 1943 at Calcutta, Mr. B. Rama Rao stated that the estimated value of India's annual production of ores, minerals and metals has been ranging now from 30 to 35 crores of rupees, which, when compared with the value of minerals, metals and mineral fuels produced annually in the United Kingdom, South Africa, Canada and Australia, stands lowest. The progress of mineral industries in India during the last fifty years, though not altogether negligible, cannot be considered to be commensurate with the country's extent and of its total population. Lack of enterprise and initiative on the part of the Indian capitalists have been responsible for this slow progress. State-guidance and Government help have not been forthcoming in as generous a measure as would be effective; the country's general ignorance of its available mineral resources and their uses is also a contributory cause.

India's present imports of various mineral products, mineral fertilisers and chemicals, etc., amount to several crores of rupees every year. Most of these,—like refined kaolin, dressed emery, graded asbestos, and industrial chemicals like the dichromates, can be easily prepared in India out of the raw minerals available in the country.

Mr. Rama Rao said that India has deposits of more than a hundred varieties of useful minerals which could serve as raw materials for several industries, but these are, however, irregularly distributed in the country. For the development of mineral industries in any part easy accessibility to the requisite mineral deposits is necessary. While some parts like Bihar and Orissa, and Southern India have a multitude of useful minerals, others like Bombay, Baluchistan and Rajputana have but a few worthy of note. After giving a succinct account of the provincial distribution of minerals and the mineral industries now existing therein, he examined in detail the scope for expansion of the metallurgical industries like iron and steel smelting, production of ferro-alloys, extraction of gold, lead, and copper, etc., and also the scope for developing various non-metal industries—like the manufacture of abrasive products; ceramic, refractory, and glass industries; mineral paints and pigments; and production of mineral fertilisers and chemicals.

Reliable information on the extent and quality of most of the deposits, in several areas, was lacking and this could be obtained only by an intensive mineral survey of each of the provinces by modern methods of prospecting. But the geological service now available for such a task was absolutely inadequate. It should be the primary function of the State to foster the rapid growth of the country's mineral industries. Mr. Rama Rao strongly urged (1) the organisation by Government of well-equipped mineral survey departments in each of the provinces, and (2) the constitution at the Centre, of a "National Mineral Utilisation Board" with several

advisory committees in respect of different groups of industrial minerals.

Indian Patents.—Mr. S. G. Sastry, B.A., M.Sc. (Lond.), Director of Industries and Commerce (Retired), writes to us as follows:—

Recently I had occasion to have some correspondence with the Controller of Patents in Calcutta on a matter of some importance to Indian scientific workers. My correspondence with the Controller of Patents and Designs referred to a particular type of sulphur burner which had been described in the *Chemical and Metallurgical Engineering of New York*. Whether the process or the apparatus already described in current technical literature which had already been patented in foreign countries could be given patent rights in India was the main issue raised by me. The Controller of Patents has given a ruling on this subject, and further he has permitted me to quote the relative portions from his letter on the subject. It is this official ruling given by the Controller of Patents that is of some importance to scientific workers in India. "... The second question is 'can any one apply for a patent if a particular invention or if a particular process which is known in other countries happens to be either unknown or little known in British India?' The answer to this question is that prior knowledge or prior use of an invention outside British India is not a bar to the grant of a patent in British India if the invention has not been publicly used or publicly known in any part of British India, prior to the date on which the application for a patent was made in this counery. An invention is deemed to be publicly known if a document containing an adequate description of it, whether issued as a general publication or not, has in the course of ordinary business and without imposing any secrecy, reached an appreciable section of the public interested in the art to which the invention relates."

Administration Report of the Government Mineralogist for 1942, Ceylon, Part II—Revenue (1).—This Report which covers some six pages of close printing, deals with the usual activities of the Department during the year.

A new mining ordinance has been introduced to improve mining conditions. Though a lot of difficulty was felt, the production of graphite has considerably increased. To encourage exploitation, the Royalty on mica has been reduced from 5 to ¼ per cent. A new welcome feature of the Department is the starting of publication of professional papers on various topics concerned with the Geology and Mineralogy of Ceylon. The Government have also started to record scientifically the fall of meteorites and to preserve them in the State museum.

On the economic side investigations on Peat tracts are progressing and more information is available on the vanadium-content of the ilmenite sands. Kaolin can be worked if a market is found for it outside Ceylon, and the occurrence of Copalite resin offers an incentive for the development of a new industry. The iron ore deposits of Ceylon have been estimated as sufficient to last the country for about a century.

Geological survey of small areas is proceeding, and the relationship between the major formations of Ceylon is becoming more and more clear.

B. V. I.

The Geological, Mining and Metallurgical Society of India: Elected Council for 1943-44. —*President*: Sir Cyril S. Fox; *Vice-Presidents*: (1) Prof. L. Rama Rao, (2) Prof. N. N. Sen; *Joint-Secretaries*: (1) Prof. N. N. Chatterjee, (2) Prof. S. K. Bose; *Treasurer*: Prof. B. N. Maitra; *Librarian*: Prof. S. Ray; *Other Members of the Council*: (1) Prof. M. Chatterjee, (2) Dr. A. K. Dey, (3) Prof. T. N. Muthuswamy, (4) Mr. P. S. Narayana, (5) Mr. N. H. Ojha, (6) Mr. N. L. Sharma, (7) Prof. Daya Swarup, (8) Prof. K. P. Rode.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory, Bombay, during the month of September 1943, there were four of moderate and four of slight intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin I.S.T.		Epicentral distance from Bombay	Co-ordinates of epicentre (tentative)	Depth of focus	Remarks
		H.	M.	(Miles)		(Miles)	
5	Moderate	15	05	3540	Lat. 5° N., Long. 125° E., near Mindanao.	..	Probably slightly deep.
6	Moderate	10	12	7070	..	90	..
9	Slight	10	36	1310	..	170	Epc.: Hindu-Kush. Felt at Rawalpindi, Muzaffarabad, Dera Ismail Khan, Gauhati, Kabul, Drosh, Gulmarg and Srinagar.
10	Moderate	15	07	3950	..	..	..
14	Slight	08	31	7180	..	..	..
14	Slight	10	13	7110	..	..	..
14	Slight	13	56	5290	..	..	..
24	Moderate	18	01	1190	Lat. 37° N., Long. 74°·5E., near the Hindu-Kush mountains	..	..

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory, Bombay, during the month of October 1943, there were one of great, one of moderate and five of slight intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin I.S.T.	Epicentral distance from Bombay	Remarks
		H. M.	(Miles)	
1	Slight	13 01	1370	..
5	Slight	17 41	1610	..
10	Slight	07 13	1360	..
22	Moderate	22 31	3110	..
23	Great	23 54	1290	Epicentral region in Assam. Reported to have been felt in some places in Assam and North Bengal.
24	Slight	20 11	4890	..
24	Slight	22 34	8330	..

MAGNETIC NOTES

Magnetic conditions during November 1943 were slightly less disturbed than in the previous month. There were 10 *quiet* days, 18 days of *slight* disturbance and 2 days of *moderate* disturbance as against 17 quiet days and 13 days of slight disturbance during the same month last year.

The quietest day during November 1943 was the 11th and the day of largest disturbance the 19th.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days	
	Slight	Moderate
2–4, 9, 11, 13–15, 17, 30.	1, 5–8, 10, 12, 16, 18, 21–29.	19, 20.

No magnetic storm occurred during the month of November in the years 1942 and 1943.

The mean character figure for the month of November 1943 was 0·73 as against 0·43 for November 1942. M. V. SIVIRAMAKRISHNAN.

We acknowledge with thanks the receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 91, Nos. 4644, 4648, 4650.

"Journal of Agricultural Research," Vol. 67, Nos. 1, 2 & 4.

"Agricultural Gazette of New South Wales," Vol. 54, Pt. 10.

"Biochemical Journal," Vol. 37, No. 3.

"Central Board of Irrigation Bulletin," No. 41 (Sep. 1943).

"Journal of Chemical Physics," Vol. 11, No. 9.

"Experiment Station Record," Vol. 89, Nos. 2-3.

"Indian Farming," Vol. 4, No. 6.

"Indian Forester," Vol. 69, Nos. 11-12.

"Bulletin of the Indian Central Jute Committee," Vol. 6, Nos. 7-8.

"Indian Medical Gazette," Vol. 78, Nos. 10 and 11.

"American Meteorological Society Bulletin," Vol. 24, No. 4.

"Review of Applied Mycology," Vol. 22, No. 8.

"Journal of Nutrition," Vol. 26, No. 2.

"Nature," Vol. 152, No. 3859.

"Science," Vol. 98, Nos. 253-39.

"Science and Culture," Vol. 9, Nos. 5-6.

"Journal of Scientific and Industrial Research," Vol. 2, No. 1.

"Monthly Science News," No. 25.

"Sky," Vol. 2, No. 11.

"Indian Trade Journal," Vol. 151, Nos. 1947-1953, 1955.

BOOKS

An Introduction to the Modern Theory of Valency. By J. C. Speakman. (Edward Arnold & Co., London), 1943. Pp. 159. Price 5/6.

ERRATA

"Coconut Shells as an Industrial Raw Material: I. Composition of Shells".—Vol. 12, p. 292, in the table *for* "SO_2," *read* "SiO_2"; p. 292, para (*iii*), Organic Constituents: line 2, *for* "W. L. Winton" *read* "A. L. Winton"; line 5, *for* "species" *read* "spices".

"The Origin of Rohr at Didwana".—Vol. 12, p. 295, para 3, line 3, *for* "months" *read* "weeks"; p. 297, Table III, Raw Brine, NaCl: Na_2SO_4, col. 3, *for* 2·8°:1 *read* 22·82:1.

SUPPLEMENT TO CURRENT SCIENCE

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THE FUNDAMENTALS OF CRYSTAL PHYSICS*

By SIR C. V. RAMAN

THE crystal is Nature's most highly finished product in the field of atomic architecture. The majority of solids we handle in our daily lives are crystals by virtue of their structure, and their behaviour is largely determined by the properties of the crystalline state of matter. The fundamental aspects of crystal physics may, therefore, be of interest to many who are not professional physicists and I feel justified in making them the subject of my address to-day. I will leave it to my friend and colleague, Dr. Birbal Sahni, to voice the appreciation by our Fellows of the kindness and hospitality of our Hyderabad friends which has made our meeting here together in these difficult days possible.

* * *

As is well known, the study of the beautiful external forms exhibited by well-developed crystals enables them to be grouped into classes exhibiting specific types of geometric symmetry. One of the most firmly established results of crystal physics is the existence of fundamental relationships between these symmetry classes and the various physical properties which the crystals belonging to them exhibit. Indeed, if the symmetry of the crystal is known, the branch of mathematical analysis known as group theory enables us to predict the general nature of its behaviour in respect of any specified physical property. By way of illustration, I may refer to a recent paper by Principal Bhagavantam in our *Proceedings*, in which he has discussed the elastic, optical and elasto-optic properties of different crystal classes and corrected the results obtained earlier by Pockels. The existence of such relationships is a natural consequence of the fact that a crystal is essentially an ordered arrangement of the ultimate particles of matter in a regular geometric pattern. Crystal architecture is based on the space-lattices which are formed by three sets of parallel and equidistant planes in space intersecting each other at a set of points which form a three-dimensional net or repetitive pattern. Each point of the lattice is occupied by an atom of the same kind, and all the atoms in the lattice are, therefore, equivalent. The simplest crystals consist of a single space-lattice and contain only one species of atom. More complicated crystals contain two, three or more sets of equivalent atoms, the space-lattices occupied by the different sets being geometrically similar and similarly situated, but not coincident. In other words, a crystal contains as many similar interpenetrating space-lattices as there are sets of equivalent atoms in it.

It is obvious, however, that a purely static conception of crystal architecture is inadequate. We must consider also the possible movements of the atoms away from the lattice points at which, on the average, they are placed. The importance of ascertaining and describing the atomic movements cannot be overemphasised. The thermal energy in a crystal is essentially the mechanical energy of such movements, and the thermal agitation of the atoms determines or modifies practically every observable property of the solid. Further, the amplitudes and frequencies of the possible atomic vibrations are determined by the forces which hold the atoms together in the form of a coherent solid. Hence, a knowledge of the atomic vibration spectrum of the crystal is essential for an understanding of its ultimate structure and indeed also of all the properties characteristic of the solid state. It is, therefore, necessary to find an answer to the question, what are the modes and frequencies of the possible vibrations of the atoms in a crystal about their positions of equilibrium in the space-lattice?

There are two ways in which an answer has been sought to this question. One way is to take the well-known theory of the vibrations of an elastic solid as the starting point and extrapolate it to the very limit. For this purpose, it is assumed that the atomic vibrations which occur on an extremely minute scale and as rapidly as a hundred or a thousand million times per second are determined by the same principles and considerations as are the visible and audible vibrations of a bell or a tuning-fork. It may be questioned whether such an extrapolation from macroscopic to molecular physics is theoretically justifiable. The other approach to the problem is the atomistic one. We fix our attention on the individual atoms located at the points of the space-lattice and ascertain the forces which come into play when they are displaced from these positions and calculate the resulting movements. It is obvious that the atomistic approach is the more reasonable one in dealing with vibrations of very high frequencies, and that it is much more likely to give us the correct results.

* Presidential Address to the Indian Academy of Sciences at its joint meeting with the National Academy of Sciences at Hyderabad, 26th December 1943.

The immense numbers of atoms involved and the complexity of the structure of many crystals might suggest that the atomistic approach to our problem would be a formidably difficult one. Actually, however, this is not the case. A very great simplification is introduced by the fact that all crystals consist of a finite number (in many cases quite a small number) of sets of equivalent atoms. Equivalent atoms have the same mass and occupy equivalent positions in the structure of the crystal. They are held in their respective environments by equivalent force-systems. In any particular mode of vibration, all the atoms must oscillate with the same frequency and with either the same or the opposite phases everywhere. The forces acting on any given atom are determined by its own displacement and by the displacements of the atoms forming its environment. These factors in the problem result in a severe restriction of the possible modes of atomic vibration. It is easily seen that the conditions stated can only be satisfied if the resultant force acting on an atom and its consequent displacement have the same magnitude and either the same or the opposite phase as the corresponding quantities for every other equivalent atom. This again is only possible if the amplitudes and phases of atomic vibration repeat themselves in a space-pattern of which the units have twice the linear dimensions and, therefore, eight times the volume of the unit cell of the crystal lattice. This doubling of the scale of the vibration pattern as compared with the static structure of the crystal is a direct consequence of their being two possibilities for the relative phases of the movements of neighbouring equivalent atoms in the crystal, namely, that they may be either the same or the opposite of each other.

The atoms whose movements describe the possible modes of atomic vibration are thus eight times as many as those included in the unit cell of the crystal lattice. Multiplying their number by a factor of three representing the degrees of freedom of movement of each atom, and subtracting from the total, the three possible movements of translation of the entire group, we get $(24p - 3)$ as the number of its possible internal modes of vibration, p denoting the number of sets of equivalent atoms in the crystal. Of this total, $(3p - 3)$ vibrations are movements of the various interpenetrating lattices of atoms as a whole with respect to each other, while the remaining $21p$ vibrations are oscillations in which the alternate planes of equivalent atoms in the crystal oscillate against each other. These numbers are very greatly reduced when the crystal possesses a high degree of symmetry, as for instance, when it belongs to the cubic, tetragonal or hexagonal class, several of the possible modes of vibration then becoming identical. The existence of symmetry also enables us in many cases to specify the directions of movement of the atoms in the crystal. A complete enumeration and geometric description of the various possible modes of vibration is, in fact, possible in the case of crystals of high symmetry and of not too complicated a structure.

The ideas and results briefly outlined here are elaborated and applied to several different crystal structures in a symposium of papers published as the November 1943 issue of the *Proceedings* of the Academy. Taking, for instance, the cases in which the crystal contains only one species of atom, Mr. G. N. Ramachandran has systematically dealt with all the fourteen possible space-lattices in turn, and showed how the number of possibilities diminishes from the 21 modes of vibration with unspecifiable directions for the triclinic lattice to the four modes with completely defined directions of the face-centred and body-centred cubic lattices. The cases of various structure types in the cubic system, *e.g.*, rock-salt, zinc blende, flourspar and cæsium chloride, have been discussed by Mr. E. V. Chelam both by purely geometric and by group-theoretical methods. The application of the analytical methods of the group theory to the problem has been considered in the symposium from two different points of view. One way is the application of the standard group-theoretical methods to the enlarged space-unit containing eight lattice cells. The other is to start with each of the eight possible classes of vibration for the unit cell of the crystal lattice shown to be possible by the dynamical theory and consider them in turn. It is very gratifying that the results obtained by Professor Bhagavantam and Mr. Chelam respectively by the two methods in the case of diamond are completely identical. They show that the diamond structure has eight fundamental frequencies of vibration, of which the highest represents an oscillation of the two interpenetrating lattices of carbon atoms against each other. Their theoretical investigations enable us to understand the very striking experimental results obtained by Nayar in his studies of the luminescence and absorption spectra of diamond at low temperatures, as also the experimental findings of Dr. R. S. Krishnan in his recent investigations on the scattering of the 2,537 mercury radiations in diamonds of the ultra-violet transparent type.

Considered broadly, the results of the present theory form a striking and even startling contrast with those generally believed in at present. We see that the atomic vibration-spectrum of a crystal is essentially discontinuous and exhibits a finite set of discrete monochromatic frequencies, which are the more numerous, the more complicated the structure of the crystal is and the lower its symmetry. This picture bears no resemblance to the older ideas of the vibration spectrum of a crystal suggested by an extrapolation from the theory of the elastic vibrations of a solid. Such extrapolation into the region of atomic vibration frequencies is the basis of the well-known theory of specific heats of solids due to Debye; it yields an immense number of frequencies forming a continuous spectrum, in which the modes of vibration aggregate more densely together as we approach the high-frequency limit assumed in the theory. The Born crystal dynamics also yields a continuous spectrum of vibration frequencies as the result of the assumption on which it is based, namely, the Born-Karman boundary conditions, also known as the postulate of the cyclic lattice. The difference between the results of the new

crystal dynamics and of the existing theories is so great that the issue between them ought to be capable of settlement by a direct appeal to the experimental facts. The relevant spectroscopic evidence has been marshalled in two reports by Dr. R. S. Krishnan and by Mr. D. D. Pant, dealing respectively with the scattering of light in crystals and with their luminescence spectra and the associated absorption spectra at low temperatures. As will be seen from the reports, these three entirely independent groups of experimental studies furnish a great mass of unequivocal and by reason of their concurrence, overwhelming evidence that the vibration spectra of crystal lattices consist of discrete monochromatic frequencies which under ideal conditions, *e.g.*, at low temperatures, are quite as sharply defined as the vibration-frequencies of a gaseous molecule.

The failure of the Born dynamics to explain the observed facts is perhaps most clearly evident in the very case which has been most exhaustively discussed by Born and his collaborators, namely, rock-salt. The vibration-spectrum of the sodium chloride structure has been worked out on the basis of the Born postulate by Kellermann, and is a continuous one with three very broad and diffuse humps or intensity-maxima. On the other hand, in the present theory, the structure has one discrete frequency of vibration representing the oscillation of the sodium and chlorine lattices against each other, and eight other discrete frequencies representing oscillations of the layers of atoms parallel to the cubic and the octohedral planes alternately against each other in specifiable directions. On account of the symmetry of the atomic arrangements in the crystal, all the nine frequencies are inactive as fundamentals in light-scattering. The theory, however, indicates that all the nine frequencies may appear as octaves in the spectrum of the light scattered by the crystal. As long ago as 1931, using the 2,537 radiations of the mercury arc, a large clear rock-salt crystal, and prolonged exposures, Rassetti obtained a very beautiful spectrogram and microphotometric record. This appears very clearly reproduced in Fermi's book of 1938 entitled *Molekule und Krystalle*. Fermi himself admitted his inability to offer any explanation for the features very clearly observed in Rasetti's spectrogram. On the other hand the present theory offers a natural and convincing explanation of Rassetti's results, as has been shown by Dr. R. S. Krishnan in his report. The spectrogram and microphotometer record alike show the nine distinct frequencies required by the new dynamics of crystal lattices, quite clearly resolved from each other.

* * *

The success of the new crystal dynamics in offering a simple and natural explanation of a great body of spectroscopic facts shows that it rests on sound foundations. Various subsidiary issues, however, arise which require to be investigated in detail. One of these is the question, are there possible modes of vibration in which the space-units of the repeating pattern contain larger numbers of lattice cells than the eight indicated by the theory? Such a possibility was envisaged by me in a paper published in the *Proceedings* of the Academy two years ago. It is readily seen, however, that all modes of vibration in which equivalent atoms have the same amplitude of vibration are included in the theory already indicated. On the other hand, if the amplitudes are different, and the vibration pattern is on a larger scale, its modes and frequencies should be capable of being described, at least as a rough approximation, by the ordinary ideas of the elastic solid theory. Hence, we are justified in ignoring all such possibilities in a treatment of the vibration problem on a purely atomistic basis. That we have to exclude the three degrees of freedom of translation of the whole group of atoms in our enumeration of their possible modes of vibration is, however, a clear indication that there are other possible modes of vibration of the crystal lattice. It is *a priori* evident that these would be of lower frequencies and would closely resemble elastic vibrations of very small wave-lengths. The investigation of such modes of vibration is not without importance when we seek to apply the ideas of the new crystal dynamics to various problems, especially the calculation of the specific heats of the simplest types of crystal at the lowest temperatures.

* * *

The basis of our discussion so far is the classical mechanics, coupled with the idea that in considering the modes of atomic vibration in the interior of a crystal of macroscopic size, the conditions at the external boundary of the crystal are irrelevant. The agreement of the results of the theory with the experimental facts shows that such disregard of the boundary conditions at the surface of the crystal is justified. It indicates also that the various possible atomic states within a crystal are to be described in terms of space-units which are either the lattice spacings of the crystal, or integral multiples thereof and not in terms of sub-multiples of an arbitrarily assumed external dimension of the solid. We are naturally led to ask, should not similar ideas be extended to other aspects of the subject of crystal physics, including especially the theory of the electronic constitution of solids? The discussion which has been organised on this subject, and of which Professor K. S. Krishnan is the opener, may perhaps help to clarify the position of the latter problem and point the way to new and significant advances in our fundamental knowledge of the crystalline state of matter.

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